

# JOURNAL OF INDIAN EDUCATION

**NON-ENFORCEMENT OF COMPULSION IN ELEMENTARY  
EDUCATION IN INDIA**

**JERK TECHNOLOGY**

**IMPACT OF SPOT TRAINING PROGRAMME  
OVER THE CLASSROOM PRACTICES OF TEACHERS**

**ENHANCEMENT OF LEARNING ACHIEVEMENT IN  
MATHS THROUGH THE USE OF TEACHERS' GUIDANCE  
THROUGH THE ACTIVITIES BASED TEACHING**



**National Council of Educational  
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# Non-enforcement of Compulsion in Elementary Education in India

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## Abstract

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*In universalizing elementary education in India the policy of persuasion and incentives has been deliberately adopted instead of enforcing legal compulsion. In the hope of accelerating progress of universalization and in the context of the recent decision to abolish child labour, the desirability of enforcing compulsion is being re-examined. The indication in this regard is from quarters which matter. Some international organizations are also understood to support the change. The matter, therefore, needs serious consideration. In fact, the National Institute of Educational Planning and Administration (NIEPA) has held a national seminar on the subject. The author holds the view that it will be wrong to enforce compulsion in the present context.*

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**E**LEMENTARY education, within the education sector in India's development plan, has been a priority area from the beginning of the post-Independence period. As a result of continuous and sustained effort, the country's elementary education system has expanded to become one of the largest in the world. The number of primary schools has increased from 2.1 lakh in the year 1950-51 to 5.6 lakh in 1991-92. The corresponding rise in the number of middle or upper primary schools has been from about 13,600 to about 1,50,000. These schools together with about 2,70,000 non-formal education centres have enrolled 13.6 crore children compared to 2.2 crore in the year 1950-51. Percentage-wise the enrolment at the primary stage has increased from 43.1 per cent in 1950-51 to 104.5 per cent in 1993-94. Corresponding figures for the middle or upper primary stage are 12.9 per cent and 67.7 per cent. These are, however, gross figures because the enrolment includes some overage and underage children also.

I guess 10 per cent to 15 per cent of the enrolment is related to the overage and underage groups. To that extent, the percentages will go down in respect of the correct age-groups. But even as gross percentages, they do indicate the enrolment capacity which has already been built up in the country's school system for children of the proper age-groups. For example, the 104.5 per cent enrolment reported in respect of the primary stage shows that the existing primary schools of the country can well accommodate all children of ages 6-11 years whenever they join the school. It should also be stated in this connection

that full 100 per cent enrolment may never be possible.

Similarly, according to the last all India survey of education conducted by NCERT in the year 1986, 94.5 per cent of rural population in the country had primary schools within a walking distance of one kilometre and 84.0 per cent of the rural population had a middle or upper primary school within a radius of three kilometres. This too is no mean achievement.

Girls' education, however, needs immediate attention. Studies and investigations have revealed a large number of factors which are responsible for higher drop-out rates and great gender gaps in enrolment of girls. They include general poverty of the people, family attitude towards education, girls' (and also boys') involvement in domestic work, early marriage, rigid school timings, lack of infrastructural facilities, shortage of female teachers, and irrelevance of curriculum. The studies also indicate some gender bias in the textbooks and other teaching-learning material as also among some teachers and administrators.

As regards the involvement of politics in this matter, it is true that during the sixties, that is, after about two decades of Independence, some people associated with school and adult education expressed the opinion that the central and state governments did not want to make their countrymen educated because the politicians wished to continue exploiting the illiterate masses for getting votes. I do not think that this allegation is correct. Presumably, this expression was based on a general feeling of disappointment and frustration due to low success in the efforts against great

hopes I have been very closely associated with the work of school and adult education for two decades (1950–1970) as one of the senior level functionaries in the then Union Ministry of Education (now Union Ministry of Human Resource Development, Department of Education). In that capacity, I have studied and monitored implementation of the various programmes of school and adult education by different state governments and union territory administrations either on the advice of the central government or on their own. I can claim to possess intimate and authentic knowledge about the success and failure in the work of both school and adult education in India. I do not think that there has been any lack of sincerity or enthusiasm on the part of any government in respect of making all citizens of the country educated as early as possible.

### Compulsion

As far as I am aware, most states in the country have passed compulsory education acts. But none of them has enforced the law. The reason is simple. The defaulting parent is too poor to pay a penalty in cash and it will be nearly impossible and fruitless for any government to find place in jail for a very large number of parents who are likely to be involved. Penalization of the parents in the present conditions in the country may even be considered to be an act of cruelty and, therefore, against human rights. Accordingly, the alternative of persuasion and incentives has been chosen and utilized. This, I think, has been the most feasible and appropriate approach under the circumstances of the case.

Why are we now considering enforce-

ment of compulsion in elementary education? Is it because we think that poverty has disappeared from the country? Or is it because some very major development has taken place, which calls for completely changing the on-going approach and taking recourse to the law of enforcement? Although general prosperity has improved a little, those whose children are still outside the primary/middle school are quite poor. It has, however, to be noted in this connection that there is now better appreciation of education for children among parents in India. But if children are not going to school, it is because they cannot afford to do so in most cases.

Mention has already been made of several socio-economic and cultural factors, apart from general poverty, which have bottle-necked faster universalization of elementary education. It is clear that none of them is going to be resolved by mere introduction of compulsion. Similarly, it need not be said that provision of physical and other facilities, especially in our rural schools, and the provision of various educational and pedagogic inputs as also the regular presence of the teacher are not going to take place automatically through mere introduction of a compulsory education law. On the contrary, enforcement of compulsion may force the governments to immediately increase the needed enforcement machinery and the facilities for the hardest core of children who are at present outside the school, namely, those in isolated pockets in the hills, on the sea shore, in the desert, in the urban slums and other places. All this may distort and slow down the present activities and trends, which may be yielding

slow results but are in the right direction. It is a question of strategy.

### Child Labour

Of late, child labour has been receiving increasing attention in the context of universalization of elementary education and otherwise. This is good. In connection with child labour, it is true that the employers of that labour have a vested interest because child labour is quite cheap and, therefore, profitable to them. Some people might think that enforcement of compulsion in elementary education will make it easier to take out the children from employment and put them in school. I do not think the matter is so simple. Resistance to the removal from work is likely to occur not only from the employers but also from the parents of the child and even from the child himself.

The parents will not want, in most cases, the removal of their child from wage-work because they need the child's earnings. Many of them may be really poor. Other parents may also not like to lose the income. The child, when enrolled in an ordinary primary school, may not be attracted to the existing situation—a school with no building or an unattractive building, no facilities for sports and games, no teaching aids or demonstration material, uninviting curriculum, and a demotivating school atmosphere generally. Above all, the child has now to exert himself on studies without any immediate and visible reward. This is in contrast with a routine type of job which he was doing during his employment, for which he was getting some money on a regular basis. Further, while in employment, he was received with warmth when he went home after work.

After enrolment in a school, he might be rebuked at home because he was not doing well in studies. What an unhappy and unwelcome situation for the child! His lack of interest in the school may increase with time and one day he may even run away from his parents and forget the school completely.

As regards shifting the child from the work, the Constitution of India vests enough power and authority in the government. Article 24 of the country's Constitution may be referred to in this regard. It states, "No child below fourteen years shall be employed to work in any factory or mine or engaged in any other hazardous employment."

What is more important about this constitutional provision is that it lays down one of the fundamental rights of the citizens of India. As a fundamental right, it is justifiable in character. In other words, it is a right which, if denied to any citizen, entitles him to seek redress in the Supreme Court or in any prescribed court of law. As a consequence, the fundamental right will be restored and the agency, authority or person obstructing the exercise of that right is liable to be punished.

Under the circumstances, the matter needing serious attention is the education and rehabilitation of the child released from work. The following suggestions may be considered in this regard.

- Every released child should be admitted to a suitable residential school at the cost of the government till he/she completes primary education. (The Union Ministry of Labour already has a budget to attend to the problem of child labour.)
- If the child's parents were dependent

on the earnings of the child and had no other source of income for their livelihood, appropriate work or financial assistance should be given to them till the child completes primary education

- If at this point the child completes 14 years of age, he should be free either (a) to work for wages in his earlier establishment or a fresh one, or (b) to continue further education on his own like other children (Five years of primary education should give him permanent literacy)
- In case the child has not yet completed 14 years of age, he should have a choice either (a) to continue to receive general education on his own like other children, or (b) to go to work for wages with the condition that he attends a general education class or a practical training centre for about two hours every day at the cost of the employer. For his two hours' general education class, a simplified syllabus may be prepared on the basis of the normal syllabus for Classes V-VIII. Some practical training centres may also have to be established for these children in our I.TIs, polytechnics or some other educational institutions. This arrangement may continue till the child reaches the age of 14 years; and we need not be too rigid regarding this part of the suggestion.

I think the flexible approach suggested in para 4 above may be extended to cover all other children as well. This may be considered to be an interim arrangement till universal elementary education becomes a reality. This flexible approach is certainly

making a compromise with the requirements of Article 45 of the Constitution. But it does provide a more feasible solution to a difficult problem.

In the case of child labour employed in hazardous employment the enforcement of compulsion is not being proposed here. This is because (a) the population of such child labour is quite small (according to the reply to a question in Parliament given by the Union Minister of Labour in May 1995, the child labour working in hazardous occupations is estimated to be "not less than 20 lakh". It may be taken to be about 25 lakh), and the same is limited to certain areas, and (b) while the result of legal compulsion may be of doubtful utility, the alternative scheme suggested in this paper may serve the purpose in view. The expenditure involved in the alternative scheme will not be heavy and will be of short duration.

The children helping their parents in domestic work, agricultural field, or professional activities like carpentry, are also classified as child labour. They are much larger in number and their case will have to be considered differently to provide minimum education for all. Most of them also belong to poor families. If they are taken away from the help they are rendering to their families and forcibly put in school, howsoever good it may be, their families will need to be compensated for the loss of the opportunity cost. Further, if they are unwillingly admitted to an ordinary school, which is likely to happen, they may pick up some elements of the 3R's but they will miss the learning of their family occupation or the general work experience and in the process get alienated in their

own society. This matter, therefore, needs very careful consideration and a mechanical enforcement of the law of compulsion is not the solution

### **Child's Right to Education**

In two recent judgements the Supreme Court of India has expressed that every child in India upto the age of 14 years has a right to education. As a right, it can be claimed by the eligible child. This fact completely changes the implications of Article 45, which states that the State shall "endeavour to provide" free and compulsory education for all children upto the age of 14 years. This target was required to be fulfilled within a period of ten years, i.e. by the year 1960

Quoting Article 21 of the Constitution, according to which the right to live is a fundamental right, and by linking education with worthwhile life, the Supreme Court has concluded that under Article 45 every child upto the age of 14 years has a rightful claim to education. Accordingly, every school-age child can now sue the State and claim free education. He or she could not do so before because the State could always get away by referring to the wording of Article 45 and pleading that it was making every possible "endeavour" to provide schooling facilities to the child. In other words, the State had so far no legal obligation to arrange for free education of all children upto the age of 14 years. It now has that legal obligation in terms of the Supreme Court judgement

### **Future Hopes**

May be, the State in India has realized seriously that it has failed to fulfil a social, if not legal, obligation to provide for free

education of all children upto the age of 14 years even after a lapse of about 50 years — a task which it was directed to complete in 10 years. May be, it has taken appropriate note of the Supreme Court judgements mentioned above and realized the possibility of serious consequences of further delaying universalization of free elementary education. May be, there is pressure of the world community and international bodies through the currently highlighted concept of Education For All. Whatever be the reason(s), elementary education is now receiving the much needed political support and its allocation in the Eighth Plan has already been raised to about Rs 9,200 crore as compared to about Rs 2,000 crore in the Seventh Plan. Further, the Prime Minister has announced more than once that the government will spend six per cent of the country's GNP on education. This will mean a very significant increase in the funds available for education. If the present priorities within the education sector as also the policy of a freeze on increase in allocation for higher education continue, bulk enhancement of funds will be in the elementary education sector

Of late, some external aid for elementary education has also become available. With the help of this aid a number of school education projects have been launched in Andhra Pradesh, Bihar, Rajasthan and Uttar Pradesh. These projects are innovative in nature and they are aimed at strengthening the teaching work, improving quality, and upgrading facilities in primary schools generally

Apart from these projects, a major programme called District Primary

Education Programme (DPEP) has also been launched. For funding it, the World Bank has given a loan. The main emphasis in planning and execution of primary education activities in future will be on area and micro-planning and involvement of the local people in a big way. These objectives are expected to secure better results through the establishment of the panchayati bodies.

The element of pre-primary education contained in the integrated programme of early childhood care and education, popularly known as ICDS (integrated child development service), has contributed to improve both the enrolment and retention in the primary schools. The same impact has generally been observed elsewhere too wherever the children started their education at the pre-primary stage. The ICDS project is all-India in character and is addressed primarily to the rural areas and the unprivileged families. It is these areas and families from which largely the school-age children are yet to be enrolled and retained in the primary school.

There is an increasing realization among education functionaries that our elementary schools should be made more attractive and interest-absorbing to the pupils. The giving-up of Basic Education initiated by Gandhiji and the adoption of the Mahalanobis model of educational planning, in which emphasis at the school stage has been on expansion alone, have done great harm to school education in India. There is, therefore, a strong case to broaden the scope of the on-going project of Operation Blackboard and to spend a good portion of the anticipated increased allocation of funds on improving physical

facilities, academic work, and the relevance of education in our schools, particularly the elementary schools. This should be done for its own sake as also for accelerating universalization of elementary education. This fact needs to be highlighted in the present context in our country instead of undertaking enforcement of legal compulsion.

Compulsion alone cannot remove any of the various socio-economic and cultural bottlenecks of a faster universalization of elementary education. This measure may, on the contrary, distract attention from the existing work and tends in order to attend to the needed requirements of the legal compulsion.

It should, therefore, be a wiser strategy to continue with the existing policies and practices and take full advantage of the increased and increasing allocation of funds as also the latest development in area-intensive and micro-level planning and implementation. More funds and attention should also be spent on providing pre-primary education through the ICDS scheme and on making the elementary school more inviting and worthwhile for all children, particularly for the child labour. If this can be done well, even the child labour may come to school voluntarily. These measures will improve elementary education, which improvement is badly needed. They will also provide a better and surer alternative to the enforcement of legal compulsion. The problem of child labour working in hazardous and other employment may be resolved through the flexible scheme suggested in this paper.

# Assessing Primary Teachers' Training Needs

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## Abstract

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*Low teacher quality is one of the significant reasons contributing to low school quality. Inservice education of teachers is being widely recognized as a significant intervention to enhance teachers' competence which, in turn, influences pupils' learning outcomes. Inservice education, to be effective, must meet the training needs of teachers. Training needs of teachers are required to be assessed systematically before training programmes are organized. Observation of teachers' classroom behaviour, questionnaires, focus group discussion, diagnostic tests, analysis of pupils' answer scripts, self assessment, periodical appraisal reports, etc. are the techniques which are used to assess the training needs of teachers.*

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**D**ECLINING school quality in the country is a matter of great concern. Learning achievement of pupils in primary grades in mathematics and the mother tongue is grossly inadequate as revealed by the baseline studies conducted by NCERT (Jangira et al, 1994) and NIEPA (Verghese, 1994). Appallingly high drop-out rate, low learning achievement, high rate of pupils' absenteeism, low enrolment at the upper primary and secondary stage, high rate of-failure at the public examinations are some symptoms of the poor health of the country's educational system.

Among the causes of the erosion in school quality are deterioration in teachers' quality, low morale and deteriorating teachers' work life. Teachers turned out by teacher training institutions are, by and large, unprepared for the tasks they are required to perform in schools. Studies have revealed that teachers get 'reality shocks' when they assume positions in schools after completing initial teacher training (Muller-Fohrbrodt, et al, 1978). This is perhaps due to the fact that their training was far removed from the real work place situation of teachers.

Inservice training of teachers is widely recognized as one of the significant interventions to improve the quality of school education. There is enough evidence to suggest that inservice education of teachers enhances their competence which, in turn, influences pupils' learning outcomes. The growing realization about the role of teachers' inservice training in quality improvement drives has led to its institutionalization in some parts of the country. A considerable investment is made in further

training and development of teachers but the benefits flowing from it in terms of improvement in pupils' learning outcomes are not visible, which may be one of the several factors responsible for the low quality of pupils' attainments.

The situation calls for attention to the quality of training imparted to teachers. The content, material, methodology and transactional approaches adopted during training are some of the important components on the quality of which rests the overall quality of training. It is generally observed that the training provided to teachers is often irrelevant, excessively theoretical, outdated and far removed from the work situation of trainees. Grossnickle (1987) observed that too often teachers feel that they have been given medicine that is not going to help them. This reveals that the training content is often not relevant to the needs of trainees. Daresh (1987) reviewed approximately 160 studies dealing with trainees' preferred training topics and desirable content for staff development and concluded that staff development inservice education proves more effective when its content is based on the self reported needs of the participants. Since training and retraining is an essential component for improving teachers' performance, the first logical step in this direction would be to evolve an acceptable framework of the assessment of teachers' training needs.

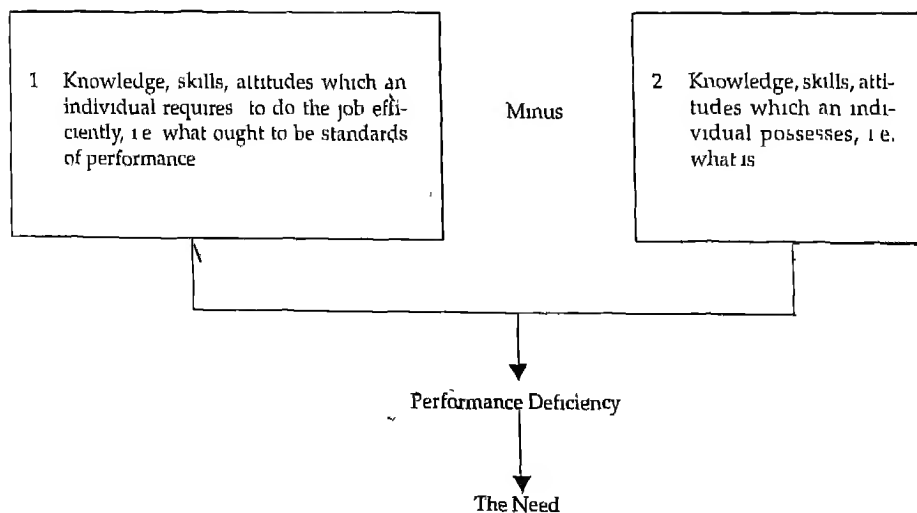
### The Need

Quite often, a professional's training need emanates from the gap between his/her actual performance and the desired level of performance. More precisely, "A need

is a discrepancy or deficiency between what is and what ought to be" (Wilson, 1987) Therefore, training need exists when a worker lacks the requisite knowledge, skills or attitudes to perform an assigned task optimally. This implies that there are standards of performance of a task against which the performance of an individual is judged. In industry, all organizations do not have set standards of performance for every task. Some have established standards but have not documented them appropriately. A number of managers generally express dissatisfaction with their employees' performance but are unable to identify precisely what level of performance would satisfy them. In the absence of standards of performance, it is difficult to pronounce that the employees' performance is not upto the mark. In view of this, there is a dire need to establish standards of performance for different tasks and to document them appropriately in print and non-print forms. Further, standards of per-

formance should be amenable to measurement or at least assessment.

The setting of standards of performance of a task shall make it easy to identify the deficiencies in the performance of the task of an individual. The difference between the expected standards of performance and the existing level of performance reflects the discrepancy or deficiency in the performance. The deficiency may be of several types, such as, deficiency in knowledge or in skills or attitudes or in execution. If the difference between the *must do* and *is doing* stems from other causes such as lack of commitment and motivation and inappropriate working conditions, then the training may not prove helpful in improving performance. It has been observed that sometimes a worker is able to do a job but because of inadequate practice, he/she is not able to perform at the desired level of efficiency. This may be labelled as 'deficiency of practice'. The following diagram may prove helpful in clarifying the concept of 'need'.



If the performance of a worker meets the standards of performance, then he/she does not require any training. On the other hand, there is need for training, if the difference between the two is significant. The assessment of a worker's existing knowledge, skills etc. reduces the training time and thus results in saving financial resources and preventing boredom.

### **Micro and Macro Needs**

The needs can further be classified as micro and macro needs depending on the number of workers exhibiting specific need. A need may be labelled as 'micro' if it exists for an individual or a small number of workers. On the other hand, macro needs exist for a large group of workers with the same job specification. For instance, all the teachers teaching Class V must be provided training to comprehend curricular areas added to the syllabus of mathematics for Class V and all new entrants of an organization need training about its policies, practices, goals, etc.

### **Teachers' Needs**

There is a deficiency in the performance of a teacher if his/her performance in the classroom does not meet standards of performance/desired level of performance. This performance deficiency may either be due to lack of mastery of content/subject taught by him/her or because of inadequate mastery over teaching skills. Besides the deficiency can also be attributed to lack of motivation and commitment to the profession and absence of conducive working conditions. If a teacher, inspite of possessing the requisite knowledge, skills and attitudes, fails to perform or refuses to perform well on account of lack of mo-

tivation, etc. further training will be of no use to him/her. On the other hand if the performance level is low because of inadequate knowledge of the subject and mastery over teaching skills, training shall definitely prove useful as it has the potential to equip the teachers with the requisite knowledge, to fine-tune the existing skills and to develop additional skills required to perform well.

### **Needs Assessment**

Assessment of training needs is a key determinant of the effectiveness of teacher training. The training of teachers in our country has been a trainer-centred activity as it is the organizers of training who determine the objectives, content, duration of training of which, trainees often feel that it was irrelevant, more theoretical, outdated or far removed from their work situation. The recent years have witnessed a progressive change in perception regarding the necessity for identification of training needs of teachers. Organizers of training programmes are now receptive to the views of teachers regarding their training needs as it is felt that the training proposed should be the result of an identified need and not the consequence of the whim/perceptions of a training officer.

Needs assessment is the "process of determining the things that are necessary or useful for the fulfilment of defensible purpose" (Stufflebeam et al., 1995). More precisely, needs assessment is the process or delineating, obtaining and applying information to determine what is useful or necessary to serve a defensible purpose.

Training needs, which are generally expressed in terms of knowledge, skills, attitudes depend upon the nature of the job

to be done and the people who are to perform the job. A variety of methods and techniques could be used for the assessment of teachers' training needs.

### **Needs Assessment of Personnel in Industries**

Three major aspects which need to be analyzed to identify training needs of personnel are job analysis, task analysis, and skills analysis. The job relates to the full range of tasks which are required to be performed which in turn require specific skills.

### **Job Analysis**

Job analysis involves a detailed description of the activities and the requirement of the job, while the job description is what the job holder should do and should be capable of doing. Job specification provides details of the skills, knowledge and attitudes required by an individual to perform the tasks involved in the job. A detailed job specification shall make it easy to identify the training needs of individuals who are to perform the job.

### **Methods of Analysis**

The analyst first identifies the job holder's responsibilities and tasks and then finds out for each task what is done, why it is done and how it is done. There are a number of methods for undertaking job analysis and the choice of methods will depend upon the characteristics of the job to be analyzed. The methods used very frequently are observation of the worker at work by the analyst, self-observation, use of questionnaire, fact-finding interviews, etc. By making an attempt to perform the job himself/herself, the analyst gets an

opportunity to have first-hand experience of the problems and difficulties related to the job.

### **Occupational Competence Standards**

After job analysis, standards of performance expected in a competent person in the occupation need to be determined which may differ from job to job. The standards of performance should be such as are amenable to measurement or at least assessment. The identified standards of performance are put to a variety of uses such as recruitment, delineation of job requirements, appraisal of performance, identification of training needs, etc.

### **Performance Appraisal**

Before an individual's training needs can be determined, it is necessary to know his/her present level of competence. The methods used for appraising the performance of workers employed in different fields include

- Observation of employees performing the job,
- Periodical appraisal interviews;
- Organizational audits and reviews,
- Performance records and production;
- Assessment centres

Observing an employee performing a job provides a great deal of information about his/her deficiency in performance. Appraisal reports of employees written by their superiors are useful to take stock of their strengths and weaknesses. Organizational audit of such matters as interpersonal relations, classroom management, school discipline, health and safety of children, etc. indicate the training needs of teachers. Some organizations use assess-

ment centres in getting the performance of their employees evaluated. These centres devise simulation exercises such as mock meetings, group exercises, role playing, in-tray exercises, etc. to test their performance. Job analysis and assessment of performance play a critical role in identifying a deficiency in performance. These provide basic information about what is required from an employee and his/her performance.

### Assessment of Teachers' Performance

Teachers' needs fall broadly in two areas — content enrichment and refinement in skills. It has been observed that organizers of training determine training needs of teachers and their trainers on the basis of their perceptions and interaction with them in formal and informal settings. Hence, topics for inservice training of different functionaries — teachers and their trainers are selected by people other than those for whom the training is intended. Research is seldom undertaken to assess systematically the training needs of teachers (Arora and Singh, 1996). Appraisal of training needs developed by different DPEP states revealed that DPEP states hardly used research as a means to identify the training needs of primary teachers. In view of this, there is a need to evolve a procedure of needs assessment for which the following techniques could be used.

- 1 Observation of teachers' classroom behaviour
- 2 Questionnaire
- 3 Fact-finding discussion
- 4 Self-assessment
- 5 Diagnostic tests

- 6 Analysis of pupils' answer scripts
- 7 Periodic appraisal reports.

#### 1 *Observation of Teachers' Classroom Behaviour*

Observing a teacher in the classroom provides a great deal of information with regard to his/her deficiency in teaching skills. It provides information as to how he/she transacts the content, what teaching skills he/she uses to transact different types of content—facts, concepts and generalizations. A detailed observation is required for analyzing teachers' classroom behaviour. Continuous observation is normally not warranted as sufficient information can usually be obtained by random sampling. Behaviours observed by the analyst are compared with the standards of performance to identify deficiencies in skills. The analyst should possess sufficient expertise in the observation of teachers' classroom behaviour.

#### 2 *Questionnaire*

This is a useful technique for determining teachers' deficiencies. It should, however, be used as a preliminary to an interview/discussion. The questionnaire should have some open-ended questions along with structure ones. Open-ended questions provide greater opportunity to the respondents to reflect on their perceptions about their needs.

Lalitha and Sharda (1997) identified hard spots for students as well as teachers in Environmental Studies (II) by administering questionnaires to them. Their study revealed the following hard spots in Environmental Studies (III) for teachers and students alike.

- Functions of various parts of the body

- Parts of a plant
- Earth— Sun rotation and the consequences
- Occurrence of day and night
- Occurrence of seasons
- Environmental pollution
- Milky Way galaxies
- Constellation
- Solar system
- Concepts of evaporation and condensation
- Water cycle

### 3. *Fact-finding Discussion*

Discussion with the teachers is another technique to determine their deficiencies in content as well as in their transactional behaviour. To derive maximum benefits from this technique, the analyst should be competent in the use of this technique which involves framing of questions and careful listening.

### 4. *Self Assessment*

The onus for identifying training needs does not necessarily rest on the employer. In a sympathetic work setting, employees tend to take the initiative and indicate their own needs for training (Delf and Smith, 1978). Appraisal by superiors many a time may suffer from bias. To avoid this, Fletcher (1984) suggests self-appraisal. Self-assessment promotes the cultivation of skills of reviewing one's own strengths and weaknesses and articulation of one's own training needs.

### 5. *Diagnostic Tests*

Teachers' deficiency in the mastery of dif-

ferent subjects — mathematics, mother tongue, environmental studies, etc. can be identified through a written test administered to them. Their responses to different items in the test reveal their strengths as well as weaknesses.

Mohapatra (1997) identified hard spots for teachers of Environmental Studies (II) for Classes III, IV and V. The sample consisted of 131 teachers drawn from 51 schools located in urban, rural and underprivileged sectors of the society. A diagnostic test was administered to teachers to identify hard spots for them. The identified hard spots are the following.

- Health and hygiene
- Characteristics of a living being in the context of animals and plants
- Difference between man-made and natural objects
- Differentiation between roots and stem
- Functions of roots, stem and leaf
- Rotation of the moon
- Function of heart, lungs and the brain
- Season and weather
- Occurrence of day and night in relation to rotations of celestial bodies
- Cloud formation
- Pollution
- Light propagation
- Specific gravity and its calculation in simple cases
- Maintenance of balance between the percentage of oxygen and carbon dioxide in the atmosphere.

Gupta, Sharma and Bhattacharjee (1996) conducted a study to identify *inter alia*

a) level of skills deficiency in primary school teachers in operationalizing MLL in the subject areas of language and mathematics, and b) training needs of teachers in content areas of language and mathematics. The sample of the study comprised 242 primary teachers of five blocks located in three DPEP districts of Assam. The study was conducted in collaboration with the DPEP Bureau (Assam) for identifying teachers' deficiencies were developed and administered to teachers. The study revealed the following deficiencies:

**A Linguistic Skills:** Spelling, opposite words, correct sentences (suffix transitive and intransitive verb), comprehension, punctuation, simple and complex sentences, letter writing, use of plural form in sentences, etc

**B Mathematics:** Place value, decimals, fractions and decimals, percentage, factors, multiples, LCM and HCF, even odd, prime and other kinds of numbers

Gupta (1996) also assessed teachers' performance in mathematics and language and identified areas of deficiencies in these subjects. The sample of the study comprised 42 primary teachers teaching Classes IV and V. The Mathematics Achievement Test (MAT) and the Language Achievement Test (LAT) developed by the NCERT for assessing the performance of children at the end of Class IV were used by Gupta for assessing teachers' deficiency in performance. The study revealed that teachers experienced diffi-

culty in solving problems relating to concepts like LCM, place value, decimal number, multiplication by zero, etc. Surprisingly, about 83 per cent of the teachers were not able to solve a problem of LCM correctly. In language, 64 per cent teachers were not able to provide a title to a paragraph. The meaning of a phrase could not be provided by 48 per cent teachers.

#### 6. Analysis of Pupils' Answer Scripts

In most schools, pupils take weekly/monthly/half yearly/annual tests. Their answer scripts do reveal their deficiencies. Common deficiencies of pupils will certainly indicate that the concerned teacher might not have transacted the content appropriately. This may also be due to lack of mastery over the content.

#### 7. Periodic Appraisal Reports

Teachers' performance in the school is appraised yearly by their superior i.e. head of the school. These reports may highlight their strengths and weaknesses. While it is relatively easy for the appraiser to assess the training needs of a teacher, it is often much more difficult for teachers to recognize and accept their limitations. An identified training need can only be considered valid if the trainees agree with it.

It is not necessary to use all the techniques for assessment of teachers' needs. A combination of some of these techniques may serve the purpose of identifying the training needs of teachers.

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# Jerk Technology

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## Abstract

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*It is a well known fact that in a majority of educational institutions the learners are passive. The question before teachers is, how can a learner be made an active learner? One way is by the use of 'jerk technology'. The author, in this paper, has mentioned the objectives of jerk technology which can be used by teachers or trainees in the training process. There can be different ways of giving jerk depending on the target group, purpose, subject matter, context, teacher's personality, etc. To make it operational the author has mentioned nine different tools of jerk technology which can be used to make teaching interesting and useful.*

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**A**LL OVER the world education has been considered as one of the important components of change, modernization and development. So many countries including India are trying to make education more effective by introducing and using the latest appropriate technology as per their capacity. The Indian Government, with its limited resources, is trying to make use of the latest technology for the improvement of education. The latest technology, like, multimedia, internet, video-conferencing, etc is available upto the school level, but not everywhere. The gap in getting the latest technology is reducing. With all sincere efforts by Central as well as State Governments, it is difficult to provide the latest technology to all schools, colleges and universities. We need a technology which can bring about improvement in education, be cost effective and that can be used everywhere. The jerk technology has been conceived with these attributes.

The common observation and experience of a majority of teachers, students, administrators, parents, etc. is that the classroom activities are generally dry. Students are not active. They can be made active by teachers. Teachers can use the latest technology during their teaching which has the potentiality to make students active. Probably this may be too much to expect from the teacher as well as the institute because teachers might not have been exposed to the latest technology and it may not be available everywhere. Further, teachers use only the lecture method because of the large class size, lack of training, lack of facilities, lack of interest in teaching, lack of time for

preparation, etc. The teacher makes the classroom activities monotonous. It may not be out of place to compare the present classroom with a bus moving on a smooth road. As per our experience, observation and stretch of imagination, one can say that in all probabilities the people sitting in a bus moving on a smooth road will sleep. The driver of the bus tells the front seat passengers not to sleep or doze. It can be said that the passengers of such a bus are inactive. To make them active, sometimes the driver suddenly applies the brakes. Bad roads, speed breakers, are also contributing to this phenomenon. All these help passengers to be active. They become active because of jerks. Similarly, through jerks students can be made active in the classroom. Due to activeness, the receptivity of students is likely to improve. In this paper various tools of jerks have been discussed. These have been tried out on varieties of students and teachers of different levels over a period of time by the author.

### Objectives of Jerk Technology

The jerk technology (JT) can be used by teachers or trainers to achieve the following objectives:

1. Make students active learners.
2. Make learning joyful.
3. Create a tension-free atmosphere in the classroom.
4. Help in making learner aware of what he understands.
5. Help increase learners' presence of mind in the classroom.
6. Establish proper rapport between student and teacher.
7. Break the monotony in the classroom.

## Difference between Jerk Technology and Stimulus Variation

Stimulus Variation is one of the teaching skills. Its main purpose is to bring variation in classroom teaching by way of changing the voice, using AV aids, gestures, etc. On the other hand, JT will require a set of skills. The appropriate set of skills for JT have to be identified through research. Stimulus Variation may be one of the skills required for JT.

## Tools of Jerk Technology

There can be different ways of giving jerk. Its selection depends on the target group, purpose, subject matter, context, teacher's personality, etc. The different tools of jerk technology are as follows

### 1 Mirror Image Writing (MIW)

Normally, it is observed that science teachers make use of the blackboard to the maximum extent in comparison to social science teachers. Teachers use the blackboard in such a way that students, without comprehending, copy the blackboard content in their copies. Sometimes even the student does not know what he has copied. Students keep on talking, exchanging jokes, reading books, doing home work, etc. as well as copying from the blackboard. It reflects that students remain inactive during the process of copying from the blackboard. In this the only good point is that the speed of writing of teacher and students is almost the same. The student does not miss anything.

In some institutes, teachers prefer to use an overhead projector (OHP) rather than the blackboard. Teachers find it easy because once the transparencies are prepared

they can be used for any length of time. These can be borrowed by other teachers too. The teachers can teach fast by sliding or moving the transparencies over the OHP. In such a situation, students try to copy everything from the transparencies. But due to the fast speed of the teacher they are unable to do so. Ultimately, it boils down to only listening and reading. Both these make a learner passive rather than active.

Can a learner be made active by the writing either on a blackboard or a transparency? Yes, it is possible. Try to read the following and feel the difference

\* OBJECTIVES  
\* RATIONALE  
\* JERK TECHNOLOGY  
\* TYPES OF JERK

You might have felt that you had to pay more attention in reading mirror image writing (MIW). You had to read letter by letter as you did when you were young. The teacher can use MIW only when he wants students to pay more attention to the important points. MIW works in almost all situations and with different learners. It does not require any additional financial support. The teacher can be self-trained. A teacher with a scientific temper would like to give it a trial.

### 2 Disproportionate Word Writing (DWW)

You might have seen advertisements along roadsides, in the TV, magazines, etc. The writing is disproportionate. It is done with the purpose of attracting the attention of the people. It can also be used by the teacher. At present, teachers mostly write uniformly on the blackboard. It does not encourage or motivate students to pay at-

tention to the blackboard writing. This situation can be reversed by using the disproportionate word writing tool as follows

## \***M**<sub>ODELS</sub> **O**<sub>F</sub> **T**<sub>EACHING</sub>

### 3. *Small Writing (SW)*

Teachers take special care of students sitting at the back of the class by writing in bold letters on the blackboard. It does not seem to help students because they remain passive. They can be made active by writing important words in such small letters that even the students sitting in the front cannot see. Almost all students will start asking what you had written the blackboard. When students ask, the teacher should not read it out. Some students might try to read on their own. It is this which makes them active and their receptivity will be better. Try to read the following from a distance

- \* Systematic
- \* Jerk Technology
- \* Objectives of Jerk Technology

### 4. *Double Negative Sentences (DNS)*

While teaching the teacher draws attention to important points by alerting the students with, "please pay attention", "listen carefully", "it is important", etc. As a consequence, some students pay attention, become active, alert, etc. But majority of the students remain inactive or not alert. For attracting their attention, try to speak important sentences by using double negative and see if it helps students to understand the point by concentrating on it. Examples are as follows.

- He has not been unsuccessful.

- I don't think that he does not misunderstand
- This test is not unreliable.
- This topic is not uninteresting.

### 5. *Unusual Sentence Construction (USC)*

By nature human beings like change. It is observed strictly in daily life but not during teaching where it is most required. The change can be brought by constructing sentences differently. To start with, it is difficult to practice but with use and passage of time, one can be quite comfortable. By using it in class one may feel the change in the level of attentiveness of the students. Some examples of unusual sentences construction are as given below

- I like you but I do not dislike him.
- Is it clearly unclear?
- Is this test reliably unreliable?

### 6. *Logically Illogical Conclusion (LIC)*

Explanation is an important ingredient of teaching. At the end of each explanation, a statement in the form of a conclusion is the most important and students are supposed to comprehend and retain it. As per experience, it is observed that students hardly feel the difference in concluding statement(s) and statements of explanation. One of the reason is that concluding statements are not differentiable. Try to draw an Illogical Conclusion on the basis of correct explanation. To your surprise you may note that those who did not speak, start speaking. Students might say that the conclusion is not correct. Without missing this opportunity, ask the student(s) the correct conclusion. At the end, the correct conclusion should be given. For example

- The use of *jerk* technology will enhance the attentiveness of students in the classroom. Due to increased attentiveness, the student's concentration may also improve. Consequently, the understanding will improve. With improved understanding, students may start asking questions. In this process, students may ask a question whose answer the teacher may not be able to tell on the spot. Frequent occurrence of this situation may hamper the reputation of the teacher. Therefore, *jerk technology should not be used in the class*.
- Whenever students work hard, and concentrate in the class, their chances of failure will *increase*.

#### 7 Use Multiple Words (UMW)

It is a common experience that people are unable to understand or comprehend everything that they read or hear. There may be many reasons for it. One of the reasons may be that the reader is unable to understand a word. Consequently, the whole paragraph or spoken sentence is not comprehended. This problem can be overcome in the class by replacing the key word by multiple words having the same meaning. The multiple words may be spoken in different languages, like, English, Hindi, Urdu, Gujarati, etc. Of the multiple words spoken in the class, some word will definitely strike the mind of the students and comprehension on the part of students might improve. Side by side, it also brings variation in the classroom which improves the classroom climate. No harm in trying it yourself. Some examples are given below.

- It is difficult, *kathin, mushkil, jetil*, etc
- Tools used in research must be reliable, *vishwasniya, bharosemand*, etc

#### 8. Give Misfit Example (GME)

Wherever and whenever possible the teacher tries to give examples with the intention to simplify the subject matter so that students of different abilities can understand. It is suggested that the teacher should give examples related to the daily life of the learners. Further, as far as possible, examples given in books should not be used during teaching. All this may initiate the interest of learners. Our experience is that still students are not taking interest in classroom teaching. There may be many reasons, but one of the reasons might be the monotonous classroom teaching. Examples given by the teacher are supposed to break the monotony of classroom teaching and facilitate understanding of the subject matter. This purpose has not been served. Does it mean that examples are not to be used in teaching? This is not the intention. In fact, examples are indispensable. There is a need to change the examples. Normally, appropriate examples are given. Along with the appropriate examples, have you ever given inappropriate examples? If yes, you must have observed that some students might have pointed out that these examples were not appropriate or that they were misfit examples. If a misfit example had not been given, the students would not have reacted. The identification of a misfit example by students reflects their understanding of the subject matter as well as attentiveness in the classroom. So it is beneficial to give misfit examples along with

appropriate and correct examples. Use misfit examples whenever you want them to be attentive or you want to test their understanding.

### 9 *Teacher's Known Mistake (TKM)*

Teachers are custodians of information, knowledge, etc. They know everything. Teachers are a storehouse of knowledge. These are some of the notions about a teacher. People must realize that teachers are human beings too. They are born with certain capacities which get developed to a certain extent through the training they undergo. Each teacher's development will be different and so also the performance in the classroom. During teaching, the teacher tries to give correct information, write correctly, draw correct diagrams, etc. Due to this, students take it for granted that whatever is done in the classroom by the teacher is correct. There is nothing wrong in it. But this notion is dangerous and sometimes may be anti-learning. It is also a fact that if students read a topic beforehand, their level of understanding will be better when the same topic is taught by the teacher. The teacher does not make mistakes, so the students are relaxed, inactive, inattentive, etc. This situation can be changed by the teacher for the benefit of the students. The teacher can make mistakes knowingly. For example, while teach-

ing computer programming, a teacher can knowingly use a wrong command. If students are attentive and understand whatever is being taught, they will immediately be able to point out the use of the wrong command. Otherwise, it will be pointed out because one of the students might be alert. As soon as it is pointed out, the non-attentive students might also become attentive. At this point, the teacher can ask why this command cannot be used. This question will provide an opportunity to students to participate actively in the classroom teaching. Thus, students will become active learners and the teacher can also get feedback about the understanding of the students.

Similarly, teachers can make mistakes knowingly while drawing a diagram, making connections in the laboratory, writing a formula on the blackboard, in spelling, etc. It is important to note and remember that if students are unable to point out the mistake, the teacher should draw their attention to the mistake by asking whether it is correct. If they are unable to point out the mistake, the teacher should point it out and explain why it is wrong. This might help in the development of critical thinking apart from making the students active learners. Thus, Teacher's Known Mistake (TKM) can be a good tool to make teaching interesting and useful.

# Science and Technology

## Education for Sustainable Development

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### Abstract

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*The kind of development that we have had cannot take us very far. Sustainable development is a possibility provided there is fundamental change in the management of world economy and the kind of development that is being sought. This can be achieved by making a fundamental change in the attitude of the future generation of planners, administrators and policy makers towards environment and development. For this it is necessary that the learners are exposed to real life situations that are at the root of environmental degradation and the subsequent problems. It is in this context, that this paper discusses the characteristics of sustainable development.*

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**I**T IS apparent that the kind of development that we have had cannot take us very far and the very survival of the human race is doubtful. It is worth reminding ourselves at this juncture of the conclusions drawn in *Limits to Growth* by the Club of Rome (Meadows et al, 1972)

1. If the present growth trends in world population, industrialization, pollution, food production resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next one hundred years. The most probable result will be a rather sudden and uncontrollable decline in both population and industrial capacity
2. It is possible to alter these growth trends and to establish a condition of ecological and economic stability that is sustainable far into the future. The state of global equilibrium would be designed so that the basic material needs of each person on earth are satisfied and each person has an equal opportunity to realize his individual human potential.
3. If the world's people do decide to strive for this second outcome rather than the first, the sooner they begin working to attain it, the greater will be their chances of success

This feeling was also reflected when the United Nations General Assembly was called for the establishment of a special and independent Commission, the World Commission on Environment and Development. The Commission discussed and debated the question of sustainable development and published its report, 'Our Common Future'. It states that, sustainable

development is possible, provided there is fundamental change in the management of the world economy and the kind of development that is being sought. It requires that a substantial proportion of the world's population change its behaviour in order to (possibly) avert the threat that will otherwise (probably) affect a world most of them will not be alive to be able to see.

"Sustainability is the nascent doctrine that economic growth and development must take place, and be maintained over time within the limits set by ecology in the broadest sense — by the interrelations of human beings and their works, the biosphere and the physical and chemical laws that govern it", states Ruchelshaus, one of the members of the Commission. The concept of a sustainable development that destroys the environment is not acceptable. The development that conserves and preserves the environment and has sustainable benefit is sustainable development. Such development, it appears, would require deliberate effort to protect the natural environment. It requires qualitative change in the growth itself so that it is less material and energy intensive and its impact is more equitably distributed over all sections of the society. Within itself, sustainable development contains two key concepts (World Commission on Environment and Development 1987)

- The concept of 'needs', in particular, the essential need of the world's poor to which overriding priority should be given, and
- the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.



It is relevant to examine the term 'development' at this stage. Generally, development is defined here as some kind of product that is obtained as a result of economic growth. The prevailing definition of development takes into account the increased production and consumption of the materials and resources such as energy, food, minerals etc. This lays emphasis on a consumer society. For sustainable development growth is necessary but it is not enough. In addition to growth it should satisfy the basic needs of the people in order to make them self-reliant, having control over their destiny. Finally, it should also be in harmony with the environment, so that it could withstand the pressure of time. In the environmental context, it requires change in our attitude towards development, to be viewed as a process that makes individuals, states, countries and nations more and more self-reliant and with greater control over their future. Agarwal (1982) views the following features as the characteristics of such a society

- participatory and resource sharing, frugal when compared to the affluent sections of the world but with a higher average standard of living for the poor majority,
- more self-reliant and independent,
- respectful to feminist concerns; more and more evidence now shows that women suffer from ill-health and malnutrition and care more for the restoration of environmental integrity than cash-hungry men

It should be recognized that the concept of sustainable development does not see

environmental protection and economic growth as mutually exclusive, conflicting objectives. It underlines the need to tailor the objectives of development based on carrying the capacity of the environment. In this context, the following points are to be kept in mind (Disinger, 1990).

- 1 The key to development is the participation, organization, education and empowerment of people; sustainable development is not production centred
- 2 Sustainable development must be appropriate not only to the environment and resources but also to the culture, history and social systems of the place where it is to occur. Appropriate technology is a demonstration of this.
- 3 Development must be equitable, fair. No social system can be sustainable over the long term, when the distribution of 'goods' and 'bads' within it is grossly unjust, especially when some part of the population is consigned to chronic debilitating poverty
- 4 Development involves the continuous balancing of opposites and breaking down barriers and separations between freedom and order, groups and individuals, work and leisure, settlements and nature

#### **Education for Sustainable Development: Issue-based Education**

The curriculum prevalent in most of the schools/colleges/universities is knowledge-based curriculum. Its focus is primarily on learning the concepts and skills

associated with a particular academic subject, devoid of social and environmental contexts and actions required to deal with them. For example, a four-year degree course in engineering contains the following unit (Barakatullah University, 1997).

*Basic Environment Chemistry (Unit V)*

Pollution, Causes of Pollution, Air Pollution and Its Types, Green House Effect, Importance of Ozone Layer, Control of Air Pollution, Water Pollution, Sources, Method of Prevention, Sewage and Its Treatment, Soil and Land Pollution and Its Control, Radioactive Pollution and Its Control.

It could be easily seen that the unit contains discussion of various types of pollution but no scope and reference to study these in the local context. The learning is primarily theoretical and social and other environmental issues are rarely touched upon.

In this context, it has been suggested (Knamiller, 1983) that science and technology education be linked with local environmental issues, issues of development and its sustainability. This would lead to better understanding of the concepts, the various conflicting forces in the society and to planning sustainable development. Udoh (1975) gives an excellent example of issue-based curriculum design. The study begins with a complaint by a girl to her teacher of being cheated by a groundnut seller. An investigation leads the class to collection of various information on the occupation of children's parents, study of factors affecting the price and production of groundnut, functions of traders and banks, working on the farm and so on.

Other similar examples can be seen in Evans (1975) and Knamiller (1983).

This kind of curriculum that could be described as issue-based curriculum (Knamiller, 1983) aims at development of skills, concepts and facts as they already exist but in the context of sustainable development and conservation of the environment. Hence, the starting point is an issue that could be raised by a student or the teacher. The children's own experiences — both inside and outside the class — form the basis of investigation. In this process, the pupils also learn how to ask good questions, gather relevant information and data, discuss the various aspects of the issue and to arrive at various alternative solutions. Accordingly, the objectives of science and technology education also are

- to become critically aware of issues and problems in one's own community and to question why things are as they are,
- to become effective investigators using the science and technology at their command and to learn how to gather, record and analyze the information
- to develop the ability to consciously take decisions on the basis of evidences and to take a stand on issues and problems, and
- to explore alternatives for social action, to consider possible ways of solving local community problems in the context of sustainable development

It also suggests the development of local, environment-based, integrated science and technology education curriculum. The purpose is to replace knowledge-based

TABLE 1  
Comparison of Issue-based and Knowledge-based Curriculum (Knamiler, 1982)

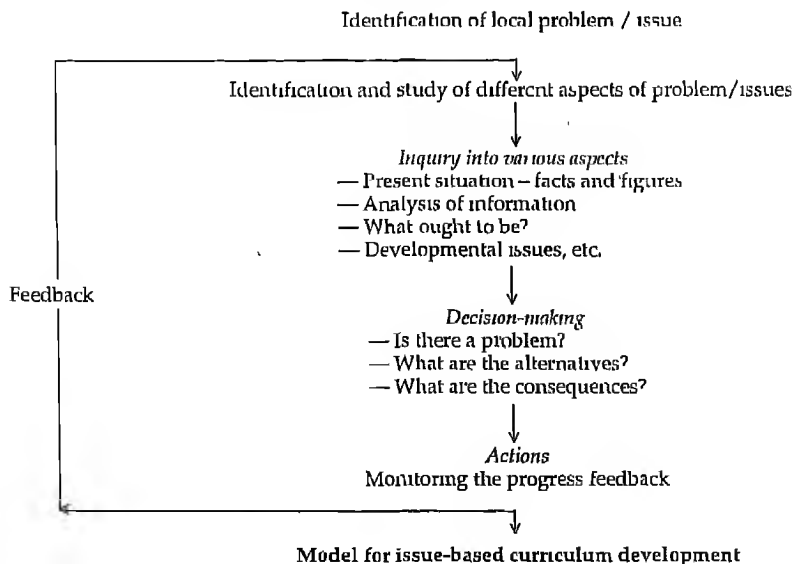
<i>Issue-based Curriculum</i>	<i>Knowledge-based Curriculum</i>
Study a local problem in the community	Study particular academic subjects (maths, science, etc )
Focus on learning the skills of gathering, recording and analyzing information for the purpose of decision-making and social action	Focus on learning the concepts and skills in a particular academic subject No focus on decision-making and social action.
Integrated approach to curriculum and learning	Subject-based curriculum and learning
<i>Assumption:</i> that children will be better equipped to take decisions and participate in community action on issues relevant to their lives when they leave school.	<i>Assumption</i> that children will continue to the next stage of schooling (i.e. will progress from primary to junior secondary to university to paid employment)

studies of the present curriculum by issue-based studies Table 1 shows the comparative characteristics of knowledge-based and issue-based science and technology education curricula. The issue-based curriculum development model is also shown below. It is based on the assumption that the exposure to real-life situations would help the learners to identify and solve the

developmental problems in a more successful way.

### Science and Technology Curriculum

The issue-based Science and technology curriculum could be developed on the lines discussed earlier. Such a curriculum assumes that it is both possible and necessary to teach science and technology with



an emphasis on rural / local / indigenous applications. After leaving the school, a pupil should be able to use his scientific skills and cognitive abilities to improve the standards of living, especially in the poorer, rural or urban areas where the majority of the population in developing countries live. He should also be able to introduce new scientific and technological concepts to improve the standards of living with an eye on its effect on the environment.

Implementing this kind of curriculum is not an easy task and involves a number of problems that the teacher encounters. It requires freedom for the teacher to shape the curriculum according to local requirements and students' interest. In most of the schools, particularly in developing countries, the curriculum is rigid with little scope for the teacher to try innovative ideas. This also requires children to leave the secure world of memorization and regurgitation for the real world of uncertainty and tentative answers. Issue-based study is also not in conformity with parents' expectations of schooling. Finally, to take a stand on a local issue may create societal problems outside the school. It is difficult to visualize to what extent this can be achieved and should be achieved. The danger is of the allegation that the curriculum was getting too political.

There is also the problem related to evaluation, which is controlled in most of the schools by a central body, may be a state board or one under the control of the Principal/Headmaster. Because of the variety of work done by the pupils in issue-based curriculum, it is difficult to develop and use the same tool for everyone. Yet, despite these difficulties, it appears essen-

tial to implement issue-based curriculum, particularly in the light of the gains that are expected from using it.

Moreover, such a curriculum would also require change in the teaching methodology. The traditional methodology that is used for science and technology education is not likely to be suitable in the envisaged curriculum. Visit to the actual site and its study, project method, experimentation and survey are more suitable methods.

Variety of activities could be conducted to discuss various aspects of a problem. For example, following are some of the activities related to air pollution that could be taken up.

#### *Activities Related to Air Pollution*

- |            |   |
|------------|---|
| Activity 1 | To survey and identify sources of air pollution in the neighbourhood. Discussion on anthropogenic activities responsible for air pollution. |
| Activity 2 | To study the effect of air pollution in a period of 24 hours duration. Discussion on causes of variation.                                   |
| Activity 3 | To study the effect of air pollution on the vegetation and health of animals. How could this be minimized?                                  |
| Activity 4 | To study the effect of air pollution on human health. What are the common diseases caused? Who are most affected?                           |
| Activity 5 | To study the methods used to reduce air pollution.  |
| Activity 6 | To study the effect of air  |

- pollution on property and materials Which materials are affected most?
- Activity 7 To identify the secondary effects of air pollution such as smog, green house effect and their consequences
- Activity 8 To study the pH value of rain water and its variation
- Activity 9 To plan strategy to reduce air pollution
- Activity 10 To carry out a campaign to make people aware of air pollution, its causes and consequences

Many more such activities could be planned and executed depending upon the interest of students, the local context, cognitive ability of the learners and local resources. Swift (1983) provides many examples of such activities that could be taken up as a project, particularly in the rural context

### Significant Features of Issue-based Curriculum

The issue-based curriculum has certain distinct advantages in comparison to traditional curriculum. These could be briefly mentioned as follows

*Cooperation of the Community*: Issue-based curriculum can be successfully implemented with the help and cooperation of

the community. The close link with the community makes it more likely to be successful. Moreover, the problem of paucity of resources can also be overcome to a large extent by involving the community members in curriculum planning and its implementation

*Accommodation for Cultural Plurality*: The issue-based curriculum recognizes the cultural plurality and diversity. In a country like India where variations are common in terms of practices, climate and religion, it is useful to provide scope for variation in curriculum. Without this it would be difficult to implement the same curriculum in regions with (maximum) temperature variations from 46 °C to 10 °C, seacoast to hilly terrains and grassy land to desert

*Integrated Learning*. This kind of curriculum leads to the understanding of the application of the principles of science and technology in everyday life. Issue-based learning helps to take a holistic view of the situation and the artificial division of science and technology into physics, chemistry, biology, electricity, mechanics, etc. is avoided leading to integrated learning. Thus the learning is more meaningful

Therefore, the issue-based science and technology curriculum could be used successfully to help sustainable development and development of a positive attitude towards the environment.

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# Effect of Scholastic Achievement and Scientific Attitude on Environmental Awareness of +2 Students of Rajasthan

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## Abstract

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*Man has been an inseparable part of the environment since his appearance on earth. The limited needs of primitive man did not disturb the harmony of nature. However, with the growth of human population and industrialization the present day environmental crisis has developed. To check this crisis, environmental awareness must be inculcated in adolescents. In this context the authors have taken up a study and have mentioned some of the implications.*

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**T**HE ENVIRONMENT IS the precious gift of nature to mankind. Man has been an inseparable part of the environment ever since his appearance on the earth. In the beginning, the limited needs of primitive man did not disturb the harmony of nature. However, with the growth of human population, industrialization, urbanization and deforestation, the present-day environmental crisis has developed. If environmental degradation is not checked in time, it will endanger man's existence on earth.

The need of the hour is to prepare environmentally conscious citizens, who are concerned with saving the environment from disaster. It might happen only when people are knowledgeable about their environment, the associated problems and their solutions. At the same time, people must be motivated to work towards those solutions.

Education has always played a crucial role in social change, because it disseminates knowledge, provides necessary skills and helps in forming certain attitudes. Environmental education is needed for the wise management of the total environment.

It is the general perception that more qualified persons or scholars are comparatively more sensitive towards the environment. In fact, their behaviour is comparatively positive regarding environment.

Scientific attitude is reflected by means of objectivity in behaviour, whereas environmental awareness concerns the preservation of nature. Adolescence (+2 stage of schooling) is a very significant stage in the life of man from the educational point of view. In fact, environmental behaviour of +2 students depends on the inputs given

in their school curriculum. This stage is most appropriate to inculcate a positive attitude, traits and habits regarding environment in the youth. Hence, it is pertinent to study to what extent scientific attitude and achievement affect environmental awareness of adolescents.

In a conference organized by the National Council of Educational Research and Training (NCERT) in 1971 at Chandigarh, a discussion was held on scientific attitude. According to the conclusions of the discussions, students with a scientific attitude should possess the following characteristics

- He/she remains clear and firm in his/her statements and actions
- His/her thinking remains always subject specific. He/she never bears biased attitudes and remains always ready to rethink
- He/she always remains ready to accept innovative ideas and inventions. His/her decisions are based on authentic and verified facts
- He/she always collects scientific matter and also keeps record of it
- He/she supports scientific experiments in the welfare of mankind.

According to another definition, curiosity, generous mode of thinking, sincerity to truth, faith in their working style and to verifying the actuality of thoughts by experimenting are the traits which come under scientific attitude.

Keep Britain Tidy Group (KBTG) (1981) has developed instructional material whose stated aim is connected with environmental awareness and language development.



Womersley and Stokes (1981) concluded that awareness was one of the objectives of education, to foster awareness of and concern about economic, social, political and ecological interdependence of rural and urban areas.

Joshi, VK (1991) in his study concluded, "the students who have higher scientific attitude, have higher environmental awareness and the students who have lower scientific attitude have lower environmental awareness".

### Rationale of the Study

To inculcate values, beliefs, attitudes and intellectual skills in adolescents, environmental awareness may also be used as a forceful means. The school curriculum has a major role in the development of environmental awareness, scientific attitude and scholastic achievement. It is also necessary to study the relationship among these variables in view of studying the effect of school curriculum. Keeping these points in mind the researchers conducted the present study.

### Objectives

1. To study the effect of scholastic achievement on different components of environmental awareness namely, Air Pollution (EA-1), Water Pollution (EA-2), Health and Nutrition (EA-3), Forest and Agriculture (EA-4), Population Growth (EA-5), and Total Ecosystem (EA-6), and Environmental Awareness as a whole (EA).
2. To study the effect of scientific attitude on different components of environmental awareness, viz. EA-1, EA-2, EA-3, EA-4, EA-5, EA-6 and EA

### Testing Hypotheses

1. There are no significant differences between mean EA scores of high and low scholastic achiever students at the +2 stage.
2. There are no significant differences between mean EA scores of high and low scientific attitude groups of students at the +2 stage.

### Terms Defined

*Scientific Attitude* It measures attitude of +2 students towards different aspects of science in the Likert type scale developed by Gupta (1997).

*Scholastic Achievement* Examination scores on final test of Class X of State Board of Secondary Education.

*Environmental Awareness* It measures awareness of +2 students towards different components of environment in the Likert type scale developed by Gupta (1997).

### Tools

The following tools developed by Gupta (1997) were used for data collection purpose.

1. Environmental Awareness Test (EAT)
2. Scientific Attitude Inventory (SAI)
3. Proforma for collecting examination scores from office records.

EAT and SAI were Likert type having three points alternatives. EAT and SAI had 36 and 38 items respectively. The psychometric properties of the tools were calculated as follows.

- SA Scale split half reliability coefficient was 83.

- SA Scale validity coefficient was 79
- EA Scale split half reliability coefficient was 80
- EA Scale validity coefficient was 75

### Population and Sample

The population of the study was delimited to all the students of the +2 stage of four districts of Hadoti region of Rajasthan State namely Kota, Bundi, Jhalawar and Baran. In all, a total of 350 male and 367 female students from rural and urban areas constituted the sample of the study.

In the first stage eight schools were selected randomly, four each from urban and rural areas from the list of total number of schools of the aforesaid four districts. All the +2 students present in the randomly selected schools constituted the sample of the study.

### Data Collection and Scoring

Data were collected through administration of the tools in the classroom situation by the investigators. After data collection scoring of students' response on EA and

SA were done by assigning a weightage of three for the correct answer, one for an incorrect answer and two for undecided answers.

### Statistical Techniques

Mean, SD and student's 't' tests were used for analysis of data.

### Interpretations

Results are presented with the help of student's 't' test tables followed by interpretation.

#### EFFECT OF SCHOLASTIC ACHIEVEMENT ON DIFFERENT COMPONENTS OF ENVIRONMENTAL AWARENESS

Data relating to scholastic achievement and different components of environmental awareness are shown below in Tables 1 to 6.

It can be observed from Table 1 that there was no significant difference between mean scores of environmental awareness regarding air pollution of high and low scholastic achievers at 01 level of significance. Hence, the null hypothesis of no difference was not rejected.

TABLE 1  
Effect of Scholastic Achievement on EA-1 Component of EA

<i>Scholastic Level</i>	<i>N</i>	<i>M</i>	<i>SD</i>	<i>SE</i>	<i>t</i>
Low Achiever	176	13.94	1.89	.143	.198
High Achiever	174	14.25	1.94	.147	NS

Note: NS – Not Significant

**TABLE 2**  
Effect of Scholastic Achievement on EA-2 Component of EA

<i>Scholastic Level</i>	<i>N</i>	<i>M</i>	<i>SD</i>	<i>SE</i>	<i>t</i>	<i>p</i>
Low Achiever	176	13.05	2.22	.168	266	
High Achiever	174	14.27	2.09	.159	NS	

It can be observed from Table 2 that there was no significant difference between mean scores of environmental awareness

high scholastic achievers at .01 level of significance. Hence, the null hypothesis of no difference was rejected at .01 level of sig-

**TABLE 3**  
Effect of Scholastic Achievement on EA-3 Component of EA

<i>Scholastic Level</i>	<i>N</i>	<i>M</i>	<i>SD</i>	<i>SE</i>	<i>t</i>
Low Achiever	176	13.10	1.90	.144	2.99*
High Achiever	174	14.08	1.74	.132	

Note: \* Significant at .01 level of significance with df 348

regarding water pollution of low and high scholastic achievers at .01 level of significance. Hence, the null hypothesis of no difference was not rejected.

It can be observed from Table 3 that there was significant difference between mean scores of environmental awareness regarding health and nutrition of low and

nificance

The mean scores indicate that high scholastic achievers were more aware of environment than their low scholastic achiever counterparts. Hence, the effect of scholastic achievement on environmental awareness relating to health and nutrition was positive.

**TABLE 4**  
Effect of Scholastic Achievement on EA-4 Component of EA

<i>Scholastic Level</i>	<i>N</i>	<i>M</i>	<i>SD</i>	<i>SE</i>	<i>t</i>
Low Achiever	176	14.73	2.42	.182	3.11*
High Achiever	174	15.71	2.03	.154	

Note: \* Significant at .01 level of significance with df 348

It can be observed from Table 4 that there was significant difference between mean scores of environmental awareness regarding forest and agriculture of low and high scholastic achievers at .01 level of significance. Hence, the null hypothesis of no difference was rejected at .01 level of significance.

was rejected at .01 level of significance.

The mean scores indicate that high scholastic achievers were more aware of environment than their low scholastic achiever counterparts. Hence, there was positive effect of scholastic achievement on environmental awareness relating to population growth.

**TABLE 5**  
Effect of Scholastic Achievement on EA-5 Component of EA

Scholastic Level	N	M	SD	SE	t
Low Achiever	176	15.22	2.20	.166	2.73*
High Achiever	174	16.02	1.94	.147	

Note: \* Significant at .01 level of significance with df 348.

The mean scores indicate that high scholastic achievers were more aware of environment than their low scholastic achiever counterparts. Hence, there was positive effect of scholastic achievement on environmental awareness relating to forest and agriculture.

It can be observed from Table 6 that there was no significant difference between mean scores of environmental awareness regarding ecosystems of low and high scholastic achievers at .01 level of significance. Hence, the null hypothesis of no difference was not rejected.

**TABLE 6**  
Effect of Scholastic Achievement on EA-6 Component of EA

Scholastic Level	N	M	SD	SE	t
Low Achiever	176	12.44	2.68	.202	1.1*
High Achiever	174	14.29	2.44	.185	NS

It can be observed from Table 5 that there existed significant difference between mean scores of environmental awareness regarding population growth of low scholastic achievers and high scholastic achievers at .01 level of significance. Hence, the null hypothesis of no difference

#### EFFECT OF SCIENTIFIC ATTITUDE ON DIFFERENT COMPONENTS OF ENVIRONMENTAL AWARENESS

Data relating to scientific attitude and different components of environmental awareness are shown below in Table 7 to Table 12.

**TABLE 7**  
Effect of Scientific Attitude on EA-1

Scientific Attitude	N	M	SD	SE	t
Low Sc Attitude	176	13.79	2.11	101	1.87
High Sc. Attitude	174	14.51	1.72	124	NS

It can be observed from Table 7 that there existed no significant difference between mean scores of environmental pollution) of low scientific attitude and high scientific attitude was not rejected. It shows no significant effect of SA on EA-2.

**TABLE 8**  
Effect of Scientific Attitude on EA-2

Scientific Attitude	N	M	SD	SE	t
Low Sc Attitude	172	12.83	2.06	158	1.39
High Sc Attitude	195	14.60	1.86	134	NS

awareness regarding air pollution of the adolescents of low and high scientific attitudes at .01 level of significance.

It can be observed from Table 8 that there was no significant difference between

It can be observed from Table 9 that there was significant difference between the mean scores of environmental awareness regarding health and nutrition of the adolescents of low and high scientific atti-

**TABLE 9**  
Effect of Scientific Attitude on EA-3

Scientific Attitude	N	M	SD	SE	t
Low Sc Attitude	172	13.19	2.17	166	5.59*
High Sc Attitude	195	14.10	1.55	122	

Note: \* Significant at .01 level of significance with df 348

the mean scores of environmental awareness regarding water pollution of the adolescents of low and high scientific attitudes at .01 level of significance. Hence, the null hypothesis of no significant difference between the mean scores of EA-2 (water

tudes at .01 level of significance.

The mean scores indicate that the adolescent population with high scientific attitude were more aware of environment regarding water pollution than their low scientific attitude counterparts. Hence,

**TABLE 10**  
Effect of Scientific Attitude on EA-4

<i>Scientific Attitude</i>	<i>N</i>	<i>M</i>	<i>SD</i>	<i>SE</i>	<i>t</i>
Low Sc Attitude	172	14.48	2.43	185	3.88*
High Sc Attitude	195	15.80	1.90	136	

Note \* Significant at .01 level of significance with df 348

there was positive effect of scientific attitude on environmental awareness related to health and nutrition.

It can be observed from Table 10 that there was significant difference between mean scores of environmental awareness regarding forest and agriculture of the adolescents of low and high scientific attitude

lescents of low and high scientific attitudes at .01 level of significance

The mean scores indicate that the adolescent population with high scientific attitude were more aware of environment regarding water pollution than their low scientific attitude counterparts. Hence, there was positive effect of scholastic atti-

**TABLE 11**  
Effect of Scientific Attitude on EA-5

<i>Scientific Attitude</i>	<i>N</i>	<i>M</i>	<i>SD</i>	<i>SE</i>	<i>t</i>
Low Sc Attitude	172	14.95	2.31	176	3.56*
High Sc Attitude	195	16.17	1.73	125	

Note \* Significant at .01 level of significance with df 348

at .01 level of significance

The mean scores indicate that the adolescent population with a high scientific attitude was more aware of environment regarding water pollution than their low scientific attitude counterparts. Hence, there was positive effect of the scientific attitude on environmental awareness related to forest and agriculture.

It can be observed from Table 11 that there was significant difference between mean scores of environmental awareness regarding population growth of the ado-

tude on environmental awareness related to population growth.

It can be observed from Table 12 that there was no significant difference between mean scores of environmental awareness regarding the ecosystems of the adolescents of low and high scientific attitudes at .01 level of significance.

### Major Findings and Discussion

As a whole it can be summarized that scholastic achievement had significant effect on SA on three dimensions, viz. health and

TABLE 12  
Effect of Scientific Attitude on EA-6

<i>Scientific Attitude</i>	<i>N</i>	<i>M</i>	<i>SD</i>	<i>SE</i>	<i>t</i>
Low Sc Attitude	172	12.36	2.57	196	1.3
High Sc Attitude	195	14.15	2.27	163	NS

nutrition, forest and agriculture and population growth. In the case of the rest of the three dimensions of SA viz air pollution, water pollution and ecosystem there was no significant effect of scholastic achievement of SA. It shows that achievement does not have equal level of effect on different dimensions of SA.

The comparison of mean scores indicates that the students with high scientific attitudes are higher scores in EA in most of the cases (EA-3, EA-4 and EA-6) than their low SA counterparts. Hence, it was observed that the scientific attitude had significant and positive effect on most of the components of environmental awareness viz health and nutrition, forest and agriculture and population growth. In the case of air pollution, water pollution and ecosystem components of EA, SA had no significant effect on EA. It reveals that logical thinking and systematic way of living/working played a major role to influence most of the components of environmental awareness of students significantly.

Scientific attitude supports environmental protection and conservation of nature. Adolescents with high scientific attitude may live a systematic and disciplined life. They may love nature and value the laws of nature. They may not disturb nature. They may like cleanliness. These characteristics support environmental conservation.

Furthermore, with SA one thinks logically about all issues of life. The students try to find out the scientific facts and actual reasons behind natural secrets. Due to this inventive tendency adolescents come nearer to their natural surroundings. Hence, having developed the scientific attitude students may not perform or support anti-environmental activities.

It further means that academically sound students will be more conscious of environmental problems and may take necessary steps to safeguard nature to some extent. It can be interpreted that if the school curriculum included issues and problems of the environment it may lead towards a better environment prone society in the future.

### Implications of the Study

The importance of any research work would be valued by its educational usefulness. To establish the feasibility and efficacy of the present research, the following implications are mentioned.

#### 1 Curriculum Aspect

Although needful subject matters from the environment point of view have been introduced in different subjects at different levels, it has been felt that more weightage should be provided to environmental aspects at relevant places in the curriculum. It is also true that there is already a

heavy burden of subjects and books. So it has been proposed that environmental education not be treated as an independent subject in the schools, but be taught as a hidden curriculum for every subject. It will be treated as an approach-centred subject and be taught by trained teachers

The syllabus on environmental education should be specific for rural and urban students at every level. It should be based on local environmental needs

## 2. *Training of Teachers*

Special training should be imparted to teachers employed in rural areas for teaching at the +2 stage. Specific short term training on "strategies of environmental education" should be designed for teachers

## 3. *Co-curricular Activities*

Specified co-curricular activities like poster display, essay and quiz competitions may be organized to strengthen the EA in adolescents

## 4 *Strategies for Non-school-going Adolescents*

Some special strategies should also be developed and managed for non-school-going adolescents. Folk dances, *nukkad natak*, etc. should be managed/organized in the local dialects for the rural masses

## 5. *Nature Clubs and Nature Visits*

Nature clubs should be established in schools. The Department of Environment, Rajasthan provides financial assistance for performing different activities of nature clubs.

Well planned nature visits bring students nearer to nature. Here students observe the plants and animals in their natural habitats. Nature visits may include visits to zoos and sanctuaries and other places of environmental importance

## 6. *School Gardens*

Development of the school garden is a good extra-curricular activity. The school garden may be treated as a natural laboratory for learning biology and other subjects in a lively environment. It develops aesthetic sense in adolescents.

## 7 *Other Activities*

Wall magazine, environmental corner/gallery, creative writing and painting related to nature/environment should be developed. Competitions have their own place in developing the desired faculties in adolescents. Competitions may be held in essay writing, drawing, painting, public speaking, reciting poems, etc.

Cultural programmes are powerful and the most effective means to change the attitudes of adolescents. Expected results in minimum time may be achieved by these means.

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# Professional Responsibilities of Teachers' Organizations

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## Abstract

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*Teachers' performance is the most crucial input in the field of education for ensuring quality education. Professional organizations of teachers need to contribute effectively in this direction by organizing various academic activities for professional growth and thus enhancing the status of teachers in the society. This paper discusses the need for considering 'teaching' as a profession and the efforts made so far in framing the code of ethics for teachers in our country. The views of the National Policy on Education 1986 regarding the role of professional organizations in improving professionalism among teachers are also highlighted. Further it will also discuss the teachers' social and educational profile. It concludes with a discussion on the professional responsibilities of teachers' organizations at the national and international levels.*

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**I**NDIA has indeed a monolithic system of education. As per the Sixth All India Educational Survey conducted by NCERT in 1997, there are as many as 5,70,455 primary schools, 1,62,805 upper primary schools, 65,564 high schools, 23,662 higher secondary schools in the country. Nearly 6,49,35,659 students have been enrolled in Classes I-V, 4,07,53,151 in Classes I-VIII, 2,50,53,624 in Classes I-X and 2,10,42,405 in Classes I-XII. Out of about 41,97,555 school teachers in the country, nearly 16,23,379 are teaching at the primary level, 11,29,747 at the upper primary level, 8,29,405 at the secondary level and 6,15,024 at the higher secondary level. Till the end of 1997-98, 444 DIETs have been sanctioned, 76 CTEs and 34 IASEs have been upgraded and 19 SCERTs have been strengthened for preparing elementary and secondary teachers. Evidently, the quality of education is linked to the academic as well as professional qualities of teachers. Teachers have always played a crucial role in preparing communities towards exploring new horizons and achieving higher levels of progress and development in society. They are the prime agents of change. The significance of the emerging role of teachers has never been so critical as at this juncture. Thus, the professional status of teachers needs to be upgraded for ensuring quality education and thereby helping in establishing the credibility of the education system as a whole. Professional organizations of teachers need to contribute effectively by way of organizing various academic activities for the professional growth of teachers.

Globally, teaching is now being recognized as a profession. But the education of

teachers in our country has yet to develop the main attributes of a profession, such as, the systematic theory, authority, community sanction, ethical code and culture, generating knowledge through research and specialization. What steps should be taken so as to develop professional ethics among teachers needs to be considered.

### **Characteristics of a Profession**

An occupation attains the status of a profession if it requires specific qualifications, skills and abilities for its performance and has a procedure for certifying its practitioners, if it has a duration-specific, systematic programme of preparation for both preservice and inservice personnel, if it has an exclusive recognized role in society, if it is founded on a distinct theory and philosophy; if a profession is governed by a code of conduct consciously evolved by its practitioners, if it has an ever growing body of knowledge with increasing number of specializations; if it is amenable to systematic experiments, innovations and research. Above all, if it has an organization or association of its own, wherein people with common interests, common concerns, common styles, common goals, common problems and a common pride come together and engage in some worthwhile discussion.

### **Teaching as a Profession**

"Teaching should be regarded as a profession. It is a form of public service which requires teachers' expert knowledge and specialized skills, acquired and maintained through rigorous and continuing study; it calls for a sense of personal and corporate responsibility for the education and welfare of the pupils in their charge"

(excerpt of Draft Recommendation of the UNESCO/ILO Expert Meeting on the Status of Teachers, January 1966). Like others, teachers feel the need for forming their own organizations which may persuade and guide their members in the profession to improve the standard of their work. Teachers are the ones whose job is 'education', whose expertise is 'education' and whose profession is 'education'. It is they who should be in a position to command respect from parents, students, policy-makers, etc.

This is possible if they have their own professional body to represent them. Such considerations will give rise to the establishment of professional organizations.

### **Code of Ethics**

Any occupation assumes the status of a true profession by virtue of its professional code of ethics. The Education Commission (1964-66) declared, among other things, that one of the functions of teachers' organizations is to establish a professional code of ethics for its members and to ensure that it is followed (p. 114).

Adherence to the code is a condition for membership or entry into a profession. This long felt need was given concrete shape at a meeting held at UNESCO House in Paris in May 1964 under the Chairmanship of Mr William Carr, the then Secretary General of the World Confederation of Organizations of the Teaching Profession (WCOTP), with the recommendation that establishment of a code of ethics for teachers, which, those entering the profession would agree to follow, either acceptable on a world scale or appropriately reflecting differences in the circumstances of different countries is essential.

The need for a code was again stressed by the UNESCO/ILO recommendation concerning the status of teachers which declared that 'codes of ethics or of conduct should be established by the teachers' organizations, since such codes greatly contribute to ensuring the prestige of the profession and the exercise of professional duties in accordance with agreed principles' (January 1966).

### **Need for Professional Organizations**

Teachers are often held responsible for poor performance. For instance, the recent World Bank report (1997) entitled *Primary Education in India*, categorically states that 'improving teachers' performance is the most important challenge for primary education in India' (p. 142). The report identifies poor subject mastery, poor teaching skills, poor motivation, poor working conditions, limited career opportunities, and very importantly, low perceived status, as the principal weaknesses of the teaching force, but the training of teachers by those who may not have excelled in education and the exhortation of teachers by those who often do not understand the spirit in which many outstanding teachers try to achieve their goals, will not solve the problem. This is where teachers' organizations can play a significant role by enabling leadership from within, which is based on professional competence, to guide the process of teacher development. Thus, teachers' organizations begin from the competence and proven expertise that exist within.

### **NPE 1986 and Professional Associations**

The National Policy on Education (1986) in its Article 9.3 declared, among other things, that 'teachers' associations must

play a significant role in upholding professional integrity, enhancing the dignity of the teacher and in curbing professional misconduct. National level associations of teachers, could prepare a code of professional ethics for teachers and see to its observance' (p 25)

The Programme of Action 1986 points out that, 'strong, unified and responsible teachers' associations are necessary for the protection of the dignity and rights of teachers as also for ensuring proper professional conduct of teachers. It would be advisable to encourage development of such associations. Professional associations of teachers will be encouraged to develop awareness of teachers towards their professional growth and development. It is necessary to stress the need for democratic functioning of all these organizations in the absence of which they tend to break into small groups and their credibility and capacity to serve the cause suffer (p.185-86).

The importance of a professional code of ethics was again reiterated in the document Programme of Action 1992. It states that 'responsible teachers' associations are necessary for the protection of the dignity and rights of teachers and also for ensuring proper professional conduct of teachers. Code of professional ethics should be evolved and adopted by all concerned within a year' (p 210)

In pursuance of the above mentioned recommendations the NCTE organized a three-day workshop at Hyderabad from 24-26 November 1986 to develop a code of professional ethics for teachers. The representatives of the various national level teachers' associations, prominent leaders,

teachers and teacher educators attended the workshop and prepared the draft code. It was circulated for wider dissemination and for eliciting necessary comments for its further improvement. A national conference was held at NIE Campus, New Delhi on 18-19 January 1988 to consider the draft code in the light of the comments received and to make further modifications therein. The national level teachers' associations like the All India Primary Teachers' Federation, the All India Secondary Teachers' Federation, and All India Federation of Educational Associations attended this workshop. The modified draft code was sent to all the national level teachers' associations requesting them to widely circulate it to the teachers' associations and concerned agencies at the state, district and local levels to discuss it.

Finally, the code was again reviewed and finalized in a workshop of national level teachers' associations and eminent educationists held at NIE Campus, New Delhi on 12-13 March 1996. The finalized code has a brief preamble indicating the goal of education in our country and the professional rights and privileges of teachers to enjoy quality life and respectable position in the society. The professional ideas are enlisted in five major areas, namely, teachers' moral duties and responsibilities towards their students in and outside the school, their interpersonal relationships; their working style and behaviour with the authorities for the betterment of the institutions; their behaviour with the parents/guardians and the public keeping in view the dignity of the profession; and their commitment to strengthen the moral and intellectual life

of the community/society and the nation. It is hoped that the present code of ethics will serve as an instrument to set norms for teachers' performance and behaviour. Now the teachers' associations at various levels may have to see its observance by the teachers.

### Teachers' Profile

As a consequence of the impact of recognition of teaching as a profession, the emerging profile of a teacher as identified by NCTE for the twenty-first century would be as follows

#### Social Profile

- Capable of appreciating the aspirations and expectations of the community
- Acts as a change agent for modernization and development.
- Capable of developing proper relationships with the local community, providing guidance and leadership to it and utilizing its resources for the development of school for relevant education

#### Educational Profile

- Capable of organizing, selecting and using learning resources with a view to facilitating learning
- Effective communicator, designer and evaluator of curriculum.
- Capable of evaluating academic/professional performance
- Effectively transacts curriculum, organizes supplementary educational activities and compensatory educational programmes for the special

category of learners

- Contacts, advises and guides parents regarding the education of their wards
- Understands the importance of inter-relationship between 'culture and education', 'culture and personality' and 'culture and values'
- Capable of organizing games, sports and other recreational activities for facilitating physical growth and personality development.
- Capable of reconstructing knowledge/experiences under different situations.

The teachers should respond to the technological advancements and the changing socio-cultural and economic contexts. It is a stark reality that the teachers of the future will need to review their skills at regular intervals. The teachers' organizations at various levels may play an important role in this regard

### Some Existing Organizations

Some of the professional organizations of teachers at the international and national levels are as follows

1. World Confederation of Organizations of the Teaching Profession (WCOTP)
2. World Confederation of Teacher Organizations (WFTO)
3. United Federation of Teachers (UFT) formerly known as the American Federation of Teachers (AFT)
4. National Union of Teachers (NUT), UK
5. Canadian Teachers' Federation (CTF)

6 Australian Teachers' Federation (ATF)

7 National Education Association of America (NEA)

8 Education International (EI)

EI is a worldwide trade union organization of education personnel, whose 23 million members represent all sectors of education from pre-school to university, 294 national trade unions and associations in 152 countries and territories

Established in January 1993 as a result of a merger of the International Federation of Free Teacher Unions (IFFTU) and the World Confederation of Organizations of the Teaching Profession (WCOTP), EI aims

- (i) To defend the professional and industrial rights of teachers and educational employees,
- (ii) To promote for all peoples in all nations peace, democracy, social justice and equality through the development of education;
- (iii) To seek and maintain recognition of the trade union rights of workers in general and of teachers and education employees in particular, notably via the promotion of international labour standards;
- (iv) To combat all forms of racism and of bias or discrimination in education and society; and
- (v) To give particular attention to developing the leadership role and involvement of women in society in the teaching profes-

sion and in organizations of teachers and education employees.

The promotion of the right to quality public education for all, the protection of international standards of human and trade union rights and equality, and the improvement of the status of education personnel are the three main priorities of EI's programme of activities, which is implemented through its five departments viz , education, trade union, human rights and equality, development cooperation, information and administration

The Secretariat Headquarters of EI is based in Europe (Brussels, Belgium) and Regional Offices are based in Africa (Lome, Togo), Asia and Pacific (Kualalumpur, Malaysia, and Fiji), Latin America (San Jose, Costa Rica) and North America and the Carribbean (St Lucia) Regional conferences are convened every three years by member organizations in each region in order to agree on EI regional policies and activities. EI's programme and budget are adopted every three years by the World Congress, which brings together delegates from all EI member organizations and observers from international organizations and inter-governmental agencies with which EI maintain strong relations. The World Congress adopts policy resolutions and elects the Executive Board, which monitors and implements the activities of the organization between Congresses. The Executive Board meets at least once a year to steer the implementation of decisions taken at the Congress.

EI holds Non-governmental (NGO) consultative status with a number of major international organizations including,

UNESCO, the International Labour Organization, the International Bureau of Education (IBE), the World Bank, the World Health Organization (WHO), UNAIDS, the Organization for Economic Cooperation and Development (OECD), and the United Nation's Economic and Social Council (UNESC).

The magazines, *Education International* and the *Monitor*, are EI periodicals. It also produces many other publications on its activities and projects

Some examples of Indian Associations at the state level are as follows

- 1 Women Teachers' Association, Chennai (1890)
- 2 South India Teachers' Union (SITU), Chennai (1909)
3. Non-gazetted Education Officers' Association (NGEO), UP (1920)
- 4 Uttar Pradesh Secondary Education Association (1921)
5. Uttar Pradesh Adyapak Mandal (1921)
- 6 All Bengal Teachers' Association (1924)
- 7 Mysore Secondary Teachers' Association (1927)
- 8 West Bengal Primary Teachers' Association (1937)
9. Maharashtra State Federation of Headmasters' Association (1944)
10. Provincial Federation of Secondary School Teachers' Association, MP (1946)
- 11 Vidarbha Federation of Secondary School Teachers' Association, Maharashtra (1946)
12. State Teachers' Union, AP (1946)

Besides state level organizations, there are national level organizations also. The National Commission on Teachers mentions the following national level teachers' organizations.

- 1 All India Federation of Elementary Teachers' Organization, Patna
- 2 National Coordination Committee of Indian Teachers' Organization, Bhubaneshwar
- 3 All India Science Teachers' Association, Delhi
4. Indian National Teachers' Congress (School Teachers, Delhi Wing), New Delhi
- 5 All India Teachers' Educational Workers' Congress, Calcutta
6. All India Urdu Teachers' Association, Hyderabad
7. Bharatiya Shikshak Mandal, Pune
- 8 All India Federation of Educational Associations (AIFEA). It was established in 1925. The constituents of this body are almost all the unions and associations of teachers in India. It has played a dominant role in advising the Government of India on certain policy matters. The objectives of AIFEA are as follows
  - (i) To promote effective programmes and plans of education for the country
  - (ii) To provide exchange of information and ideas among teachers, parents and educationists.
  - (iii) To safeguard and improve the status of the teaching profession in India and to secure its legitimate place in national life by



promoting among teachers a sense of national responsibility and professional efficiency

- (iv) To unify members of the teaching profession at all levels from the pre-primary to the university
  - (v) To cultivate goodwill by active participation in international teachers' and educational conferences.
- 9 All India Primary Teachers' Federation (AIPTF) The constitution of the All India Primary Teachers' Federation was approved at its first Foundation Conference at Nagpur on 7 January 1954. The scope of this organization is all the states of India. AIPTF aims:
- (i) To inspire primary teachers throughout the country to involve themselves actively in the development of economic, educational, political, mental, moral and cultural aspects,
  - (ii) To include the sense of service and sacrifice among primary teachers for education and to enhance their social status in the society,
  - (iii) To improve the educational system based on the needs of independent India through a sense of cooperation;
  - (iv) To bring all the primary teachers under a single organization and to inculcate among them the feelings of brotherhood and a sense of cooperation;

- (v) To protect the rights of primary teachers and to create awareness regarding their service conditions, duties and responsibilities;
- (vi) To cooperate with other national and international professional organizations with similar aims and objectives;
- (vii) To publish journals, reviews and statistics regarding primary education and to cooperate with any teacher's organization which undertakes publication work,
- (viii) To seek financial aid from the central, state or private bodies in order to organize seminars, conferences, exhibitions and inservice training for teachers;
- (ix) To popularize education among illiterates, semi-illiterates through books, pictures, sketches, AV aids, etc and to establish adult education centres,
- (x) To organize debate competition, to conduct examination and to distribute prizes, scholarships, certificates, grants to successful teachers and students,
- (xi) To coordinate and supervise activities and to finalize rules and regulations of other member organizations;
- (xii) To provide necessary facilities for member organizations to participate in educational tours, annual/special conferences, etc.

It has nearly 14 affiliated associations with 20,00,000 members. The federation has secured better pay scales for teachers in Bengal, Orissa, AP and Maharashtra

## 10 All India Secondary Teachers' Federation (AISTF)

Teachers working in the field of secondary education throughout the country assembled in Delhi from 28 to 30 October 1961 and formed this association. Its immediate objective was to press for the evolution of a uniform policy on secondary education and to seek the enhancement of the status of teachers.

The federation held a national seminar on a uniform pattern of secondary education during May 1962. Further, it demanded a Secondary Education Grants Commission and uniform pay scales and service conditions for secondary teachers throughout the country. It has sought representation of secondary teachers on all advising and guiding bodies on education at Central and state levels. The federation has affiliated organizations in the various states. It has a General Council, Executive Committee and 12,00,000 members. The official journal of AISTF is *The Madhyamik Shikshak Sandesh*.

Many countries have some associations of teachers concerned with different disciplines. Some examples of such associations in India are the National Association of Teachers of Mathematics, the Indian Science Congress (which has a section on Psychological and Pedagogical Sciences), the Indian Social Science Congress (which also has a section on Education), the All India Science Teachers' Association; the All India Association of Secondary School Teachers, etc.

After India's independence, a good number of teachers' organizations have been formed. There are 102 organizations at the state level, of which 41 are for sec-

ondary and higher secondary teachers, 31 for primary teachers, 15 for both primary and secondary, seven for headmasters and the remaining eight for language, science, physical education and craft teachers. Of the 102 associations, 27 have their regular journals and magazines, and 16 publish newsletters and bulletins.

Some teachers' organizations plan to organize orientation programmes and refresher courses for inservice education of teachers to keep them abreast of the latest developments in education. They will also conduct research, hold seminars and conferences on the latest educational issues for teachers' professional growth. For instance, AIFEA has organized in the past, international conferences like the All Asiatic Educational Conference at Varanasi and WOCTP conference at New Delhi. Besides, teachers' organizations can also discuss current educational issues with the authorities and suggest workable plans for sorting out the issues.

## Responsibilities of Professional Organizations

The professional responsibilities of teachers' organizations as identified by various international organizations are as follows:

- (i) Teachers' organizations should bring the needs of education and educators to the attention of all forces promoting the well-being of society and, by cooperation with and assistance to these forces where possible, encourage them to make their proper contribution to the welfare of children in particular and society in general (WCOTP Assembly of Delegates, 1956).

- (ii) Teachers' organizations and governments have the responsibility to attract to the profession quality teachers. The recruitment of unqualified personnel diminishes the quality of education and the status of the profession (WCOTP Assembly of Delegates, 1963)
  - (iii) Education authorities and teachers' organizations should accept the responsibility for the exchange between countries of their experience and knowledge in education programmes and development (WCOTP Assembly of Delegates, 1965)
  - (iv) Teachers' organizations should be recognized as a force which can contribute greatly to educational advance and which therefore should be associated with the determination of educational policy (UNESCO/ILO Expert Meeting, 1966)
  - (v) Teachers and Teachers' organizations should seek to cooperate fully with authorities in the interests of the pupils, of the education service and of society generally (UNESCO/ILO Expert Meeting, 1966)
  - (vi) Professional standards relating to teachers' performance should be defined and maintained either by the authorities in collaboration with the teachers' organizations or by the teaching profession itself (UNESCO/ILO Expert Meeting, 1966)
  - (vii) Teachers and their organizations should participate in the development of new courses, textbooks and teaching aids (UNESCO/ILO Expert Meeting, 1966).
  - (viii) There should be close cooperation between the competent authorities, organizations of teachers, of employers and workers, and of parents as well as cultural organizations, and institutions of learning and research, for the purpose of defining educational policy and its precise objectives (UNESCO/ILO Expert Meeting, 1966)
  - (ix) Authorities and teachers should recognize the importance of the participation of teachers, through their organizations and in other ways, in steps designed to improve the quality of the education service, in educational research, and in the development and dissemination of new improved methods (UNESCO/ILO Expert Meeting, 1966)
- Some of the functions of teachers' organizations as mentioned in the Report of the Education Commission 1964–66 are as follows
- (i) To secure for their members, individually and collectively, their rightful status—social, economic and professional;
  - (ii) To safeguard their professional interests and to secure satisfactory conditions of work and service;
  - (iii) To secure the professional growth of teachers through refresher courses, seminars, publications, library service and research;
  - (iv) To work for the improvement of education in response to the challenge of the ever-changing socio-economic situation,
  - (v) To improve the teaching of subjects through the establishment of subject-teachers' associations, and

- (vi) To establish a professional code of conduct for teachers and to ensure that it is followed by members. (7.114)

Such activities serve as a basis for teachers in facilitating students' learning, improving their academic performance, transacting curriculum effectively and in organizing various educational activities successfully

The National Commission on Teachers organized a national seminar in New Delhi during September 1983. The following ten roles of teachers' organizations were suggested in the seminar.

- (i) Improving the professional service of its members;
- (ii) Improving teaching conditions and economic status with special reference to hilly, rural, desert and inaccessible areas;
- (iii) Introducing the profession to the public,
- (iv) Undertaking research publications, inservice development programmes and advancing the academic interest of the profession of teachers,
- (v) Improving teaching methods and the academic and professional training of teachers,
- (vi) Building national atmosphere for the profession with regard to professional ethics, equitable salaries and curriculum development;
- (vii) Establishing subject teachers' associations and conducting seminars and

workshops during vacation regarding upgrading of syllabi and courses of studies;

- (viii) Creating an awareness in the public of the need for development of good education and eradication of social evils like communal riots, casteism, dowry, etc
- (ix) Serving as a clearing house for ideas, and as a unifying factor among many points of view to reflect generally the broad perspective concerning the development of teachers; and
- (x) Taking interest in single teacher schools with regard to their academic viability and providing basic reference material (1981).

A reorganization and subsequent value-orientation of the educational system is a pre-requisite for the development of a democratic, socialistic, secular India committed to social justice. The nation places faith in the teaching community as nation builders and hopes that teachers would strive to give to the teaching profession the respect that is due to it by playing the role of guides and active agents in socio-economic change.

Ultimately, teachers must realise that, "We are a great organization. Great not because of size but because of nobility of purpose. We are a strong organization. Strong not because of numerical strength but because of the unity of objective we display in diversity. We are a rich organization. Rich not because of the financial clout we enjoy but because of richness in thought and values."

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# Impact of SOPT Training Programme on the Classroom Practices of Teachers in Karnataka

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## Abstract

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*The impact study of Special Orientation for Primary Teachers (SOPT) training programme was initiated by NCERT during 1997 in several parts of our country, wherever the SOPT training programme was in vogue. In Karnataka the study was carried out in two districts to find out the impact of SOPT training programme on the academic awareness of primary school teachers; and on the classroom practices of teachers. From the findings, it is inferred that the training programmes need to improve in certain aspects, which the paper highlights through a detailed analysis and discussion.*

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**S**PECIAL orientation for primary teachers (SOPT) is a centrally sponsored scheme under the Ministry of Human Resource Development (MHRD), Government of India launched during 1993–94 in our country on a massive scale with a target of 4.5 lakh primary school teachers every year. The NCERT was entrusted with the responsibility of planning, programming, organizing, conducting and monitoring besides providing academic inputs. The main objectives of SOPT were to

1. Provide competencies as envisaged in the national report on MLL
2. Develop competencies in the use of material supplied to primary schools under the scheme of Operation Blackboard (OB)
3. Encourage the teachers to adopt child-centred approach to learning
4. Encourage participation of trainees through interactive mode of training with a focus on skill and activity-based teaching—learning process

The SOPT training was organized in a hierarchical manner wherein, the key resource persons were trained by NCERT for a duration of five days consisting of 19 sessions. The key resource persons, in turn, trained the resource persons for seven days of 27 sessions, and the resource persons, in turn, trained the primary school teachers. The key resource persons are largely from the SCERT/DSCERT and some of the DIET faculty, whereas the resource persons are from the DIETs as well as some of the selected primary school teachers. In the planning, preparation and implementation of SOPT programme, institutions and or-

ganizations at national, state, district and local levels were involved.

At the national level, for bringing out the uniformity in the implementation of SOPT throughout the country, NCERT prepared detailed guidelines pertaining to selection of centres, key training persons, resource persons and teachers, and modalities for the conduct of the programmes and norms of expenditure. It also identified nine contextual themes and seven curricular areas for transaction in the seven-day programme and prepared necessary instructional material in the form of 'self instructional package' for primary school teachers. Apart from the self-instructional package the Central Institute of Educational Technology (CIET) of NCERT provided media support in the form of ETV programmes for the SOPT project to telecast in the national network. During the training programme of resource persons and primary school teachers, some of the Regional Institute of Education (RIE) faculty acted as observers to monitor the training programmes.

### **Focus of the Present Study**

A national level programme of this magnitude was to be evaluated for its impact in order to make it relevant and effective in the subsequent years of its implementation. The DTEE of NCERT developed guidelines in collaboration with the RIEs to study the impact of SOPT training programme on the classroom practices of primary school teachers at various states. The Regional Institute of Education, Mysore was entrusted with the responsibility of conducting the project in Karnataka in 1997. The main focus of the

present study was to 1) study the impact of SOPT training programme on the academic awareness of teachers, 2) study the impact of SOPT training programme on the classroom practices of teachers.

### Sample of the Study

In Karnataka, SOPT training programme has been carried out in most of the districts, except for Belgaum, Raichur, Mandya and Kolar districts which were District Primary Education Programme (DPEP) initiated districts. It is found that a total number of 28,812 teachers have been trained till September 1997 under SOPT in Karnataka.

According to the national design evolved for the conduct of the project at various states, around 200 to 250 teachers undergoing the SOPT training in 10 per cent of the districts of the selected states would constitute the sample of the project. Based on this design, out of 17 non-DPEP districts where SOPT was implemented, the teachers who were undergoing the third level training programme during February—March 1997 in two non-DPEP districts, namely Chikmagalur and Mangalore (10 per cent out of the total number of districts of Karnataka) were chosen under each district. Five centres were identified as the representative sample of the study where the SOPT training was carried out. A total number of 456 primary school teachers who underwent the SOPT training programme at 10 centres in Mangalore and Chikmagalur Districts constituted the sample of the study. The number of teachers who underwent the SOPT training programme in Mangalore and Chikmagalur Districts is provided in the Table 1.

TABLE 1  
Number of Teachers at Each Training Centre of Mangalore and Chikmagalur Districts of Karnataka

Sl No	District	Sample Size
I.	Mangalore District	
1	Hebri	40
2	Mudan Kappu	47
3.	Mudipu	48
4.	Belamanu	42
5	Siddapura	45
	Total	222
II	Chikmagalur District	
1	Sringeri	48
2	Koppa	50
3	Kadur	42
4	Chikmagalur	48
5	Mudigere	46
	Total	234
	Total sample of both districts	456

### Tools of the Study

In order to study the impact of SOPT training programme on the classroom practices of teachers, the following tools were developed by experts from RIEs and the Department of Teacher Education and Extension, NCERT.

1. *Academic Awareness Questionnaire (AAQ)* was used to find out the knowledge gained by the teachers in the specific areas in which the training was provided to them under SOPT. The questionnaire consisted of 40 items which were based on different modules of content awareness (27 items) and performance building (13 items).



2. *Personal Information Schedule* was developed in order to obtain the background information of teachers like sex, age, category of caste, academic and professional qualifications, training experience, type of school in which the teachers worked and participation in any inservice training programme
3. *Perception of Teachers about SOPT Training* was developed with an aim to study the perception of teachers about SOPT training received at the respective centres. The schedule consisted of nine components namely, physical facilities available at training centre, equipment and library, training materials, audio-visual aids and media support, transactional approaches, overall observation made and lastly the weaknesses and strengths of the programme
4. *Focus Group Discussion (FGD)* was planned as an extension of the above tool in order to find out the quality of training provided to the teachers under SOPT training. The intent of FGD was to promote self-disclosure among participants about the training programme by creating proper group environment and skillful probing, so that their free and spontaneous reactions could help in identifying certain factors about the training programme.
5. *Classroom Observation Schedule (COS)* was developed in order to find out the impact of SOPT training on the teachers' classroom practices. The schedule consisted of seven components, viz ,

i) learner-centred approach, ii) activity-based teaching, iii) use of Operation Blackboard materials, iv) use of support materials, v) evaluation strategies, vi) remedial instruction, and vii) multigrade teaching

### Data Collection — Two Phases of the Study

#### *Phase I*

This involved the administration of tools. The AAQ was administered at all centres of Mangalore and Chikmagalur districts to the teachers as pre-test on the first day of the SOPT training programme. Again, it was administered as post-test on the seventh day which was the last day of the SOPT training programme. Along with AAQ, the teachers' perception tool about SOPT training programme was also administered on the seventh day of the training programme. In addition to the administration of tools, a focus group discussion was held at the training centres. The group members of the focus group ranged from seven to nine in Mangalore District and six to seven in Chikmagalur District. On the whole, 40 teachers constituted the sample for focus group discussion in Mangalore District, whereas in Chikmagalur District 26 teachers constituted the sample, as focus group discussion was not conducted in Koppa centre due to certain unexpected constraints.

#### *Phase II*

This involved the observation of classroom practices of some of the teachers who underwent the SOPT training programme.

In Chikmagalur District 30 teachers were observed, and 38 teachers were

observed in Mangalore District for their classroom performance in order to study the impact of the SOPT training programme on their classroom practices. Two lessons of each teacher were observed by using the classroom observation schedule

### Analysis and Interpretation of the Data

#### Analysis of Teachers' Academic Awareness

The impact of the study was determined by considering the means of pre- and post-test scores of academic awareness which is represented in Table 2.

It is found that there is an impact of SOPT training programme on the academic awareness of teachers, which is evident for Koppa, Kadur, Chikmagalur, Hebri and Madankappu centres of

Chikmagalur and Mangalore Districts. The SOPT training programme seems to have had no impact on the academic awareness of teachers in Sringeri, Mudigere, Mudipu and Belamannu centres. Considering both the Districts on the whole, it is found that SOPT has had an impact on the academic awareness of the teachers. Even Karnataka State as a whole shows the impact of the SOPT training programme. The study also shows that there is no difference between male and female teachers in their academic awareness.

#### Analysis of Teachers' Perception about SOPT Training Programme

Certain research questions were raised regarding teachers' perception about the SOPT training programme pertaining to

TABLE 2  
Means, SD and 't' Values Obtained on Pre- and Post-academic Awareness of Teachers

Sl No	Name of the Centre/ District/State	N	Pre-test Mean-SD	Post-test Mean-SD	't' value		
1	Sringeri	48	15.85	3.80	16.71	3.79	1.72 <sup>NS</sup>
2	Koppa	50	15.06	4.81	16.40	3.19	2.36 <sup>**</sup>
3	Kadur	42	15.08	3.54	16.95	3.07	2.51 <sup>**</sup>
4	Chikmagalur	48	17.02	3.93	20.33	3.12	6.25 <sup>**</sup>
5	Mudagele	46	17.80	3.44	17.33	2.93	0.70 <sup>NS</sup>
6	Hebri	40	12.76	3.47	14.68	3.62	2.38 <sup>**</sup>
7	Mudanakuppu	47	13.50	4.23	18.28	3.55	5.82 <sup>**</sup>
8	Mudipu	48	14.13	3.52	14.92	3.69	1.02 <sup>NS</sup>
9	Belamannu	42	15.26	4.06	16.19	3.65	1.38 <sup>NS</sup>
10	Siddapura	45	14.79	4.06	15.13	3.96	0.40 <sup>NS</sup>
11	Chikmagalur Dist.	234	15.94	4.54	17.91	3.49	5.27 <sup>**</sup>
12	Mangalore Dist.	222	14.18	3.94	15.90	3.82	4.65 <sup>**</sup>
13	Karnataka State	456	14.62	4.97	16.48	4.30	6.06 <sup>**</sup>

NS- Not Significant

\*\* Significant at 0.01 level

- (i) Physical facilities
- (ii) Equipment and Library
- (iii) Training material supplied in the training programme
- (iv) Use of audio-visual materials
- (v) Transactional approaches
- (vi) Resource faculty
- (vii) Management of training

(i) *Physical Facilities* . Most of the teachers have expressed that boarding and lodging facilities were inadequate at the centres, though other physical facilities like furniture, toilets and room facilities were found adequate by them.

(ii) *Equipment and Library* . Most of the teachers (98 per cent) perceived that blackboard, chalk and duster were found in all the centres, whereas TV, VCR, OHP and library facilities were not available at most of the centres.

(iii) *Training Material* . Most of the teachers (94 per cent) were satisfied with the quality of paper and printing language used in the modules (93 per cent) and relevance of training materials (88 per cent) respectively. It seems that only half of the teachers had received the training materials in advance, whereas the rest of them had received them either on the first day or during the course of the training programme.

(iv) *Audio-visual Equipment* . Around 97 per cent of the teachers perceived that excepting the mathematics kit, other audio-visual equipment were not available at the training centres. Though some media support (56 per cent)

seemed to be available, the technical cooperation for media support was not available at most of the centres.

(v) *Transactional Approaches* . At almost all the centres, the most frequently used approach was the lecture method (64.25 per cent), lecture-cum-demonstration (69 per cent) and group discussion (72 per cent). The demonstration on the use of OB materials was found to be satisfactory by most of the teachers.

(vi) *Resource Faculty* . Around 97 per cent of the teachers were found satisfied with the competencies of the resource faculty.

(vii) *Management of Training* . Most of the teachers were found satisfied with the existing duration of the training programme and the management aspect of the programme.

The focus group discussions held at various centres revealed that training programmes helped them to gain knowledge in MLL competencies, teaching strategies, use of OB kit, etc. They expressed a need to know about multigrade teaching and continuous and comprehensive evaluation. It was felt that the modules on multigrade teaching, physical education and work experience were not transacted effectively, though it was expressed that the training programme helped them. At no centre was there an opinion regarding the complete effectiveness of the training programme. Similarly, though it was expressed on perception schedule that the duration of the training programme was adequate, during the FGD, some teachers have suggested that the duration of the training be extended to 10 days.

### Analysis of Teachers' Classroom Practices

The teachers' classroom practices were analyzed component-wise independently. A picture of the overall competence of teachers is provided in Table 3.

**TABLE 3**  
Mean and SD Values Obtained on Overall Competence of Teachers in Their Classroom

Sl No.	Centre/District/State	Mean	SD
1.	Sringeri	90.21	34.95
2.	Koppa	72.00	36.42
3.	Kadur	74.00	28.36
4.	Mudagere	51.00	26.68
5.	Hebri	63.53	28.67
6.	Mudanakupu	85.10	24.10
7.	Mudipu	110.80	15.67
8.	Chikmagalur Dist.	74.82	34.81
9.	Mangalore Dist.	84.10	27.60
10.	Karnataka State	79.88	31.40

It is observed that the mean value is found to be 79.88. This proves that the SOPT training programme has helped more than half the sample of teachers to acquaint themselves with the minimum competencies in the use of OB materials and other materials supplied in the training programme.

There was no difference between male and female teachers (Chikmagalur  $t = 0.41$ ; Mangalore  $t = 0.84$ ); monograde and multigrade teachers ( $t = 1.08$ ) in their classroom practices. As regards the relationship between the academic awareness of the teachers and their classroom practices, the results were not encouraging. The interaction effect of academic and professional

qualifications on academic awareness and classroom practices of the teachers was found significant, whereas the age and experience of the teachers seemed to be having an influence over the classroom practices of the teachers but not on their academic awareness.

From the findings of the study, it is inferred that there is a need to improve the training material on continuous and comprehensive evaluation, physical education, work experience and most importantly on multigrade teaching. There is need to provide demonstration on multigrade teaching to the teachers either through simulation exercises, or through real classroom situation. The findings reveal that there is no difference between multigrade and monograde teachers in their classroom practices which is contrary to reality. A separate classroom schedule for observing the teachers from the multigrade context is required. It is felt that a study of this kind should be implemented on a large scale in many districts of the state in order to know the real impact of the SOPT training programme. As observed some of teachers belonging to Mangalore District did not show any improvement in their academic awareness even after the SOPT training. This could be on account of certain drawbacks in the training programme itself. The dilution of the effectiveness of the training could be due to the cascade model on which it is based. Therefore it becomes imperative to observe and monitor the training programmes organized at all levels in order to study the effectiveness of SOPT in the real sense.

# Impact of Modular Approach on the Achievement of Slow Learners in Social Science

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## **Abstract**

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*The present experimental study was undertaken with two objectives in view: (i) to develop modules in social science for Class VIII in order to teach slow learners, and (ii) to measure the effectiveness of modular approach with special reference to slow learners. Two matched groups of slow learners were constituted for the purpose of this experiment and a normal group comprising average and above average students was also formed in order to assess how far modular approach enables the slow learners to cope with normal students. The control group and the normal group were taught through traditional picture method while the experimental group was taught through modular approach. The obtained results show that the modular approach was more effective than the traditional lecture method in teaching social science and it enabled the slow learners to cope with normal students to a considerable extent.*

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**T**HE PROBLEM that every educator invariably encounters in teaching every subject, at every grade level of our educational system is how to teach a lesson to a class that consists of students with different skills, learning rates and learning styles. Accommodating instruction to student differences is one of the most fundamental problems and the foremost task of any teacher. The problem of accommodation instruction to individual differences is so important that many educators have subtly suggested that instruction be completely individualized so that every student can work independently at his or her own rate.

The students who are generally unable to cope with the work normally expected of their age group are called slow learners. These students with less than I Q 90 are traditionally labelled "dull normal" and they are generally slower to "catch on" to whatever is being taught if it involves symbolic, abstract or conceptual subject matter. But it is really not that they learn so slowly as that they lag behind in developmental readiness to grasp the concepts that are within easy reach of the majority of their age mates. Such children will eventually grasp these basic concepts or subjects fairly easily but about a year or two later than their age mates (Jenson, 1980). They lack concentration, retention and abstract thinking. As a result, they find it very difficult to keep up with their age group.

But, these slow learners constitute such a considerable percentage of student population that they cannot be ignored. Also, one cannot conceive of any all-round national development without ensuring

adequate human resource development. Effective and optimum utilization of other resources also depends on the degree of human resource development. Children of today are the citizens of tomorrow and they are going to be the pillars of this country. Hence, it is very essential to ensure that each pillar is as strong as the other. This warrants a special instructional strategy for the slow learners. Since education functions as the kingpin of national development, we have to ameliorate the learning process of slow learners also.

Study of social science instils in students values of our culture and heritage. It not only ignites the spark of national feeling but also cultivates a sense of citizenship responsibilities. The very fact that social science is the vital subject which makes a student a good citizen, warrants a special instructional strategy for slow learners.

### **Need for the Study**

The slow learners lack concentration. They cannot concentrate on the instructional presentation for more than 45 minutes. In the modular approach a single unit is divided into three to four conceptual sub units. Each sub unit constitutes the subject content for development of one module. The duration of each module is 20 to 25 minutes only. So slow learners will be able to concentrate on the concept as it caters to the short span of attention of the slow learners.

A learning module is a self contained and self instructional package dealing with a single conceptual unit or subject matter. It can be used in any setting, convenient to the learner and the learners can complete the module at his own pace. It

may be used individually or in small learning groups. In this way modular approach accommodates instruction to individual differences. Hence the modules are suitable to the students and are more effective for slow learners.

One of the most frequent complaints about slow learners is the weakness of their memory. Of all the problems that hamper educational progress, the most frequent is a weakness in what may be termed long-term memory. Slow learners need to go over the material more times before it is fixed in their mind, and more frequent revision is required to prevent forgetting. The efficiency of the initial learning is important as well as actual retention and recall. Modular approach takes care of these problems by providing frequent revision and repetition in each module.

The slow learners are very poor in abstract thinking. It is because they are unable to understand the relationship between things. They are slower to perceive and use possible association. Meaningful associations are of great importance not only for comprehension but also for prolonged retention. The learning materials presented in the module for each objective, the project work and the practicum incorporated in the learning module enable the slow learners to surmount the problem of abstract thinking and to understand the possible association which will, ultimately, tell upon their retention.

It is a fallacy to think that just because slow learners are limited in intelligence, they can only learn by rote memorization. They also can achieve meaningful learning where there is concrete presentation of

subject matter. Slow learners must understand as much as they can of what they are learning, and then they need more repetition, revision and practice to ensure retention. Modular approach takes care of concrete presenting of subject matter by incorporating necessary diagrams, sketches, pictures, worksheets, examples, dimensional drawings, etc. with the learning material at appropriate places. Also, modular approach provides for the required review, repetition, and revision by highlighting the main points in learning materials, various tests and in recapitulation and summary. It provides for practice in project work and practicum. Thus, in many ways, the modular approach proves to be suitable for slow learners. Hence, to prove the effectiveness of modules with special reference to slow learners a study of this sort is warranted.

Dhamija (1985), Hopper (1982), Sahajahan (1980), Ramar (1994), Reddy and Ramar (1994, 1995) have conducted experimental studies on the effectiveness of modular approach. Soundararaja Rao and Rajaguru (1995) have conducted studies on slow learners but not related to effectiveness of modular approach.

Systematic researches are, therefore, necessary to develop modules so as to assess their effectiveness with special reference to slow learners. We cannot afford to ignore the slow learners who constitute a sizeable portion of the student population. The present study is an attempt to develop models in social science for the use of slow learners studying in Class VIII and to measure their effectiveness and also to assess their advantage over the traditional lecture method.

### Objectives of the Study

The main objective of the study was to develop modules in social science for Class VIII and to assess their effectiveness with special reference to slow learners. Keeping the above main objective in mind, the following specific objectives were framed.

- (i) To find out whether there is any significant difference between the pre-test and the post-test mean scores of the slow learners in the control group
- (ii) To assess whether there exists any significant difference between the pre-test and post-test mean scores of the slow learners in the experimental group
- (iii) To find out whether there is any significant difference between the post-test mean scores of the experimental group and the control group.
- (iv) To assess whether there exists any significant difference between the post-test mean scores of the slow learners in the control group and the students in the normal group
- (v) To find out whether there is any significant difference between the post-test mean scores of the slow learners in the experimental group and the students in the normal group.

### Hypotheses of the Study

- (i) There exists no significant difference between the pre-test and post-test mean scores of the slow learners in the control group when the subject is taught through traditional lecture method.
- (ii) There exists significant difference between the pre-test and the post-test

mean scores of the slow learners in the experimental group when social science is taught through modular approach

- (iii) There exists significant difference between the post-test mean scores of the slow learners in the control group and the slow learners in the experimental group.
- (iv) There exists significant difference between the post-test mean scores of the slow learners in the control group and the students in the normal group.
- (v) There exists no significant difference between the post-test mean scores of the slow learners in the experimental group and the students in the normal group

### Methodology

Experimental method was followed in the study. Module and supporting multimedia packages were developed for social science of Class VIII. In the development of modules the guidelines given by the NCERT were followed by the investigator. Each selected unit was divided into three to four conceptual sub-units. Each sub-unit constituted the subject content for development of one module. Each module was developed in a self contained and auto-instructional manner.

The modules were prepared for the same topic under different media software so as to suit the taste and interest of the students. The students could, therefore, use one or more variety of learning modules. Here the same specified components of a module were incorporated in each medium software but the nature of the medium stood dominating in the present-



tation of the particular module. Thus ample opportunities were made available to the students to listen to an audio lecture on the topic or to see a video on it

The modules thus developed were then subjected to individual and group try-outs. On the basis of the ratings, and analysis of the try-outs, necessary corrections, modifications, refinements etc were made in the modules. Both the try-outs ensured better refinement and perfection of modules. The agreement of views of experts who reviewed the modules was taken as the index of the validity of the content of the modules.

After editing and validation, the modules were made available to the experimental group of slow learners for self learning. All the required arrangement for practicum were also made. They were closely guided in the project work. The teacher's role was restricted to the extent of guiding the slow learners in the project work and facilitating the slow learners' learning process.

### Identifying Slow Learners

For the purpose of this investigation the slow learners were identified on the basis of a three-phase process. The phases are

- (i) Identifying phase
- (ii) Scientific Confirmatory phase
- (iii) Counter-check phase

For the first phase, the third measure recommended by Tansley and Gulliford (1962) which incorporates the first, second and fourth measures of Chintamanikar (1982) was followed.

In the second phase, the identified slow learners were subjected to a scientific

confirmatory test. For this purpose Standard Progressive Matrices designed by J. C. Raven and successfully and effectively used by Soundararaja Rao and Rajaguru (1995) in the Indian setting was administered to them as a scientific confirmatory test. In the confirmatory test, those who got less score (below 18/60 or below twenty-fifth percentile point) and took more time, were classified as slow learners. Lastly, these slow learners were counterchecked on the basis of their rate of learning as suggested by Kirk (1972).

### Sample Design

For the purpose of this investigation, 50 slow learners of Class VIII from S.S.H.N. Higher Secondary School, Muhavur were selected as stated above. Out of the fifty slow learners finally selected for the study, two groups were formed following systematic random sampling technique. They were placed in an order merit. All the odd number students formed the control group while the even number students constituted the experimental group. To see whether both the groups were matched or not mean and standard deviation were calculated for their half yearly exam scores and RPM scores. Then t-test was applied. The obtained t-values (0.62) and (0.78) revealed that both the groups were matched ones before the experiment. The control group was taught through traditional lecture method while the experimental group was taught through the modular approach.

To assess how far this modular approach enabled the slow learners to cope with normal students, a normal group comprising average and above average students was also formed. For this group, out of 150

students every sixth student was selected on the basis of systematic random sampling technique. This normal group was also taught through traditional lecture method only.

### Tools Used

The Following tools were used in this study

- (i) Standard Progressive Matrices designed and standardised by J C Raven
- (ii) Modules for the selected units of social science of Class VIII developed and validated by the investigator
- (iii) Achievement Test constructed and validated by the investigator

### Data Collection

The experiment was conducted for a period of thirty working days. At the end of the experimental period, a post-test was conducted on the slow learners of the experimental group, the slow learners of the control group and the students of the normal group. The responses given by these three groups formed the vital data required for the analysis.

### Scoring Procedure

The achievement test consisted of 100 objective type questions. These test items

were selected on the basis of item analysis. The total score of the test was 100. For each correct answer, the score was one and for each wrong answer, the score was zero.

### Statistical Techniques Used in the Study

The data thus obtained were then analyzed by using appropriate statistical techniques such as mean, standard deviation and t-test.

### Findings and Conclusion

- 1 The control group slow learners showed significant difference between the pre-test and the post-test mean scores when they were taught through traditional lecture method. Further, their achievement in the post-test is better than their achievement in the pre-test (refer Table 1)
- 2 There is significant difference between the pre-test and the post-test mean scores of experimental group slow learners when social science is taught through the modular approach. Further, their achievement is higher in the post-test than in the pre-test (refer Table 2)

Moreover, an analysis of rate of progress made by both control group and experimental group throws light on the effectiveness of the modular approach in teaching

TABLE 1  
Pre-test and Post-test Scores of Control Group

Name of the Test	N	Mean	SD	Calculated t-value
Pre-test	25	22	3.46	4.12**
Post-test	25	25.6	4.38	

\*\* Significant at 0.01 level

**TABLE 2**  
**Pre-test and Post-test Scores of Experimental Group**

<i>Name of the Test</i>	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>Calculated t-value</i>
Pre-test	25	21.6	3.32	14.26**
Post-test	25	42	6.34	

\*\* Significant at 0.01 level

social science to slow learners. From a meagre mean score of 21.6 in the pre-test, they could gain an impressive mean score of 42.0 in the post-test, which is almost double the pre-test mean score. But the control group slow learners could not make significant mean gain in the post-test. This vouches for the advantage of the modular approach over the traditional lecture method with special reference to slow learners.

- 3 There is significant difference between the post-test mean scores of the control group slow learners taught through traditional lecture method and the experimental group slow learners taught through modular approach. Further, the achievement of the experimental group slow learners is higher than the achievement of the control group slow learners (refer Table 3).

Moreover, the rate of progress made by the experimental group slow learners is higher than that of the control group slow learners. In terms of percentage, the rate of progress shown by the experimental group slow learners taught through the modular approach is 94.4 per cent while the rate of progress made by the control group slow learners is 16.36 per cent. The variation in the rates of progress made by both the groups is the resultant product of implementation of modular approach and it vouches for the effectiveness of the modular approach with special reference to slow learners.

- 4 There is significant difference between the post-test mean scores of the control group slow learners and the normal group students. Further, the achievement of normal group students is higher than the achievement of control group slow learners (refer

**TABLE 3**  
**Post-test Scores of Control Group and Experimental Group**

<i>Name of the Group</i>	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>Calculated t-value</i>
Control Group	25	22.6	4.38	10.64**
Experimental Group	25	42.0	6.34	

\*\* Significant at 0.01 level

**TABLE 4**  
Post Scores of Normal Group and Control Group

<i>Name of the Group</i>	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>Calculated t-value</i>
Normal Group	24	50.6	10.2	11.26**
Control Group	25	25.6	4.38	

\*\* Significant at 0.01 level

Table 4).

The mean value (25.6) obtained by the control group slow learners reveals that, though they have made progress (from 22 to 25.6) by traditional lecture method, they could not narrow down the gap between them and the normal group students. It means that the traditional lecture method could not enable slow learners to cope with normal students.

5. There is significant difference between the post-test mean scores of the experimental group slow learners and the normal group students. The achievement of normal group students is higher than the achievement of experimental group slow learners (refer Table 5)

However, a critical analysis of mean values signifies that the experimental group slow learners significantly im-

proved their achievement after the experiment. Moreover, the modular approach enabled the experimental group slow learners to cope with normal students to a greater extent. The narrowed down gap of difference between both the groups bears testimony to the effectiveness of the modular approach. Further, a comparative study of Table 4 and Table 5 testifies to the advantage of the modular approach over the traditional lecture method.

#### Implications of the Study

1. The results of the study have proved that the modular approach is more effective than the traditional lecture method in teaching social science of Class VIII to slow learners. When it is very effective for slow learners, it has to be equally effective, if not more to other backward students like under-achievers, low achievers, etc.

**TABLE 5**  
Post-test Scores of Normal Group and Experimental Group

<i>Name of the Group</i>	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>Calculated t-value</i>
Normal Group	25	50.6	10.2	3.58**
Experimental Group	25	42.0	6.34	

Significant at 0.01 level

2. Teachers of Middle School and High Schools can be given orientation on how to develop modules and supporting multimedia packages. This will give a better preparedness to ensure optimum human resource development.
3. Keeping the result of the study in mind, the NCERT and SCERTs may take up the onerous task of developing modules for each subject as they produce teacher's handbooks and these can be supplied to all the schools so that the teachers can effectively make use of these modules, if not for the benefit of the entire class, at least for the benefit of the slow learners, low achievers and under-achievers since the modules, being self contained and auto-instructional, cater to individual differences
4. Since the use of the modular approach enhances the achievement of slow learners, it will diminish wastage and stagnation in our schools. So, the teachers should be adequately prepared by means of orientation programmes. Such orientation may be given at the DIET level also, so that awareness about the modular approach can be developed among the primary school teachers

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# Enhancement of Learning Achievement in Mathematics of Handicapped Children through Activity-Based Teaching

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## Abstract

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*The study attempts to identify the hearing difficulties of Class II hearing-impaired children on various competencies of multiplication. Employing pre-test, post-test single group design on fourteen hearing-impaired children with activity-based remedial teaching, it was revealed that activity-based teaching approach helped 64.3 per cent of the children in attaining mastery over multiplication competencies. It is equally noteworthy to mention that boys excelled girls in acquiring mastery level competencies in multiplication. Solving word problems in multiplication was found to be difficult for both boys and girls. This result is consistent with the findings available for children without hearing impairment.*

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**V**ARIOUS research studies have reported that learning achievement of primary school children in general and mathematics in particular is far from satisfactory. The first survey of achievement of primary school children in mathematics conducted in 1965-66 (Kulkarni, 1970) and the second national survey on attainment of primary school children in mathematics and language conducted by Shukla et al in 1990 revealed low level of hearing achievement. Similar studies undertaken by Dave and others (1988), Shukla et al (1994), NCERT, NIEPA and New Concept Consultancy (1994), Saxena et al (1995), Prakash and Panda (1996) have also reported that numeracy and computational skills of primary school children are extremely low

In the age of science and technology, a strong base of mathematics is absolutely necessary for all. Therefore, how to develop the basic mathematical competencies among young children has been a problem for teachers, researchers etc. Keeping in view the developmental level of primary school children, developmental psychologists like Piaget, Bruner have emphasized the use of concrete objects for the development of mathematical concepts and skills. Mathematics is basically abstract in nature and to learn its various concepts, principles and rules, the child must be exposed to various context-specific activities with concrete objects. The NPE, 1986 and its programme of action have also recommended that child-centered and activity-based process of learning should be adopted at the primary stage. First generation learners should be allowed to set their own pace and be given

supplementary remedial instruction. As the child grows, the component of cognitive learning will be increased and skills organized through regular practice. In the context of primary mathematics, the M.L.L. document (1991) has specified that concrete objects and mathematical equipment need to be used throughout the primary level in mathematics. Therefore it is needless to mention the importance of activity-based teaching for the development of mathematical competencies among primary school children. This idea has well-tested support from empirical studies.

Many researchers are constantly engaged to study the effect of remedial measures using various activity-based strategies on the attainment level of primary school children. Das and Barua (1968), Rastogi (1983), Dutta (1986), Bhardwaj (1997), Bhanja (1990), Mishra (1991), Das (1996, 1998), Dash (1996), Panda (1996), Goel (1997), Sahu (1997), Behera (1998), Singh (1998), Tewari (1998) designed their studies to identify specific learning difficulties of elementary school children in mathematics and provided remedial measures in the form of self-learning activities with adequate scope for practice. The findings of their studies have revealed that these intervention strategies have really enhanced the learning achievement of children in mathematics.

But, unfortunately, most of these researchers have taken general children as their sample without giving due attention to handicapped/disabled children, who constitute a significant segment of the children studying in primary schools. It has been really a neglected area. From the point of view of universalization of

elementary education it is equally important to understand the problem of this category of children very carefully and provide appropriate interventions for qualitative and quantitative improvement of their education. A major reason for the inadequate number of research in this field may be due to lack of interest and expertise among the research institutions and researchers. Therefore it is high time the researchers gave their attention to this group of children and provided research-based intervention strategies for improving their learning outcomes. With this background in view, the present study has been designed with the following objectives

### Objectives

- 1 To identify the learning difficulties of handicapped primary school children in mathematics
- 2 To provide remedial teaching through activity-based approach using concrete materials.
- 3 To determine the effect of remedial teaching on learning achievement of handicapped children.
- 4 To compare the learning achievement of handicapped boys and girls after the remedial teaching.

### Hypotheses

- 1 Learning difficulties in mathematics exist in handicapped children at the primary level.
- 2 Activity-based teaching will enhance learning achievements of handicapped children in mathematics irrespective of sex

### Methodology

#### Sample

All the 14 Class II hearing-impaired children of Sri Harsha Mishra Memorial Deaf School, Bhubaneswar were taken as sample. These students possessed addition and subtraction skills but were poor in multiplication and its related skills as reported by the concerned mathematics teacher of the school on the basis of their classroom performances.

#### Tools

Two parallel forms of diagnostic tests were constructed on competencies related to multiplication for Class II. These competencies are "concept of multiplication as repeated addition and symbol of 'x' and '=' (2.2.7 and 2.2.8)", "multiplication tables of 1,2,3,4,5 and 10 (2.2.9)", and "day-to-day word problems on multiplication (2.2.10)". The investigator developed two sets of 17 diagnostic tests in each set with six items related to sub-competencies 2.2.7 and 2.2.8, carrying one mark each, eight items related to 2.2.9 carrying one mark each and three items related to 2.2.10 carrying two marks each. The total marks assigned for 17 items of each set was 20. The first set of questions was meant for pre-testing and post-testing after the end of the second session of remedial teaching and the second set was meant for post-testing after the first remedial teaching.

#### Design and Procedure

The single group pre-test and post-test design was planned for this study. Accordingly 14 hearing-impaired children of Class II were tested through the first set of diagnostic test as the pre-test. Those who



secured 80 per cent and above of the maximum score (i.e. 20) were levelled as Masters (M) and the rest were Non-masters (NM). With the help of the mathematics teacher of the school, the investigator conducted activity-based teaching for four weeks using activity-based materials developed by the Regional Institute of Education, Bhubaneswar (1998). The concept of multiplication, its symbol and tables were developed using concrete objects and figures followed by guided practice activities for joyful learning and problem solving. The post-test-1 was administered to over 14 children and as per the criteria indicated above Masters and Non-masters were classified. The Masters were given multiplication tables of 6,7,8,9, as enrichment lessons and Non-masters were further put under remedial teaching with another set of activities followed by a second post-test. Pre-test and post-test scores of hearing-impaired children in multiplication are given in Table 1. Table 2 shows pre-test and post-test mean scores of Masters and Non-masters. Percentage of Masters and Non-masters of the whole group (N=14), boys (N=8) and girls (N=6), before and after first and second phases of remedial teaching are given in Tables 3 and 4, respectively.

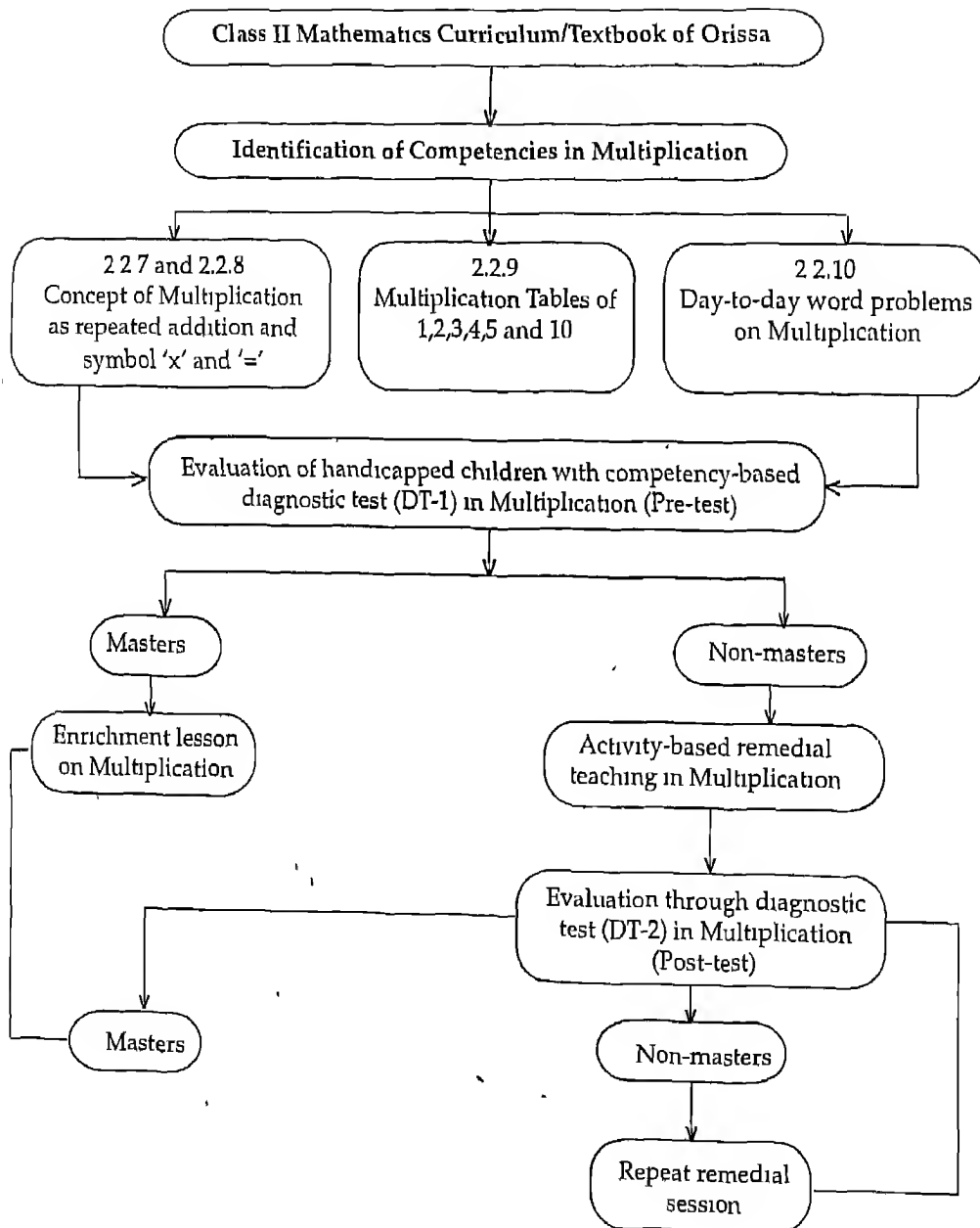
## Discussion

From Table 1, pre-test scores clearly revealed that all 14 hearing-impaired children were found to be non-masters in multiplication. From post-test (1) score, it was found that six students acquired mastery level competencies and eight students continued as non-masters, although they improved their achievement score as com-

pared to their pre-test scores. After the second phase of remedial teaching, it was found that only three students acquired mastery level and the remaining five failed to do so although they improved their achievement scores. From the first and second phase of remedial teachings it was clear that activity-based teaching has certainly enhanced learning achievement of children in multiplication. But pre-test and post-test scores on word problems were extremely low which may be due to language deficiency and other related arithmetics skills. This finding is consistent with the findings of Jitendra et al, (1998). This demands adequate practice for which more time is required. Pre-test and post-test mean scores of Masters and Non-masters as presented in Table 2 confirm the trend of improvement of the hearing-impaired children in multiplication.

Table 3 shows percentages of Masters and Non-masters in multiplication, before and after remedial teaching. The trend clearly shows that after the first remedial teaching 42.86 per cent of the children have become masters and at the end of the second remedial teaching another 37.50 per cent of the children acquired mastery level competencies in multiplication. Masters and non-masters in respect of sex have been given in Table 4 before and after remedial teachings. This indicates that 62.50 per cent of boys and 16.66 per cent of girls acquired mastery level after the first remedial teaching and 33.33 per cent of boys and 40 per cent of girls were found to be masters and non-masters respectively after the second remedial teaching. The findings of the study revealed as a whole that boys excelled girls in mastery level, so far

### Conceptual Framework of the Study



**TABLE 1**  
**Pre-test and Post-test (1 and 2) Scores of Class II Hearing-Impaired Children (N=14) in Multiplication**

Competency No with M.S		Pre-test Scores					Post-test Scores (1)					Post-test Scores (2)				
Sl No of the Students	M.S. in 2.2.7 & 2.2.8	M.S in 2.2.9	M.S.in 2.2.10	Total M.S	Remarks	M.S in 2.2.7 & 2.2.8	M.S in 2.2.9	M.S in 2.2.10	Total M.S	Remarks	M.S in 2.2.7 & 2.2.8	M.S in 2.2.9	M.S in 2.2.10	Total M.S.	Remarks	
1 (B)	5	5	2	12	NM	6	7	3	16	M	-	-	-	-	-	
2 (B)	5	6	2	13	NM	6	7	5	18	M	-	-	-	-	-	
3 (B)	4	4	1	09	NM	5	4	3	12	NM	6	7	3	16	M	
4 (B)	5	6	4	15	NM	6	8	6	20	M	-	-	-	-	-	
5 (B)	5	6	3	14	NM	6	8	5	19	M	-	-	-	-	-	
6 (B)	5	5	3	13	NM	6	6	4	16	M	-	-	-	-	-	
7 (B)	3	3	0	06	NM	4	3	1	08	NM	5	5	1	11	NM	
8 (B)	2	2	0	04	NM	4	2	0	06	NM	5	4	1	10	NM	
9 (G)	5	4	3	12	NM	6	7	4	17	M	-	-	-	-	-	
10 (G)	4	5	0	09	NM	5	6	2	13	NM	6	8	3	17	M	
11 (G)	4	5	1	10	NM	5	5	2	12	NM	6	8	2	16	M	
12 (G)	4	2	0	06	NM	5	4	0	09	NM	5	5	2	12	NM	
13 (G)	3	2	0	05	NM	4	3	1	08	NM	5	4	1	10	NM	
14 (G)	3	3	0	06	NM	4	3	1	08	NM	5	4	1	10	NM	

M.M. for 2.2.7 &amp; 2.2.8 competencies is 6

M.M. for 2.2.10 competency is 8

M.M. for 2.2.9 competency is 8

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**TABLE 2**  
**Pre-test and Post-Test (1 and 2) Mean Scores of Masters and Non-masters in Multiplication**

Test	Pre-test	Post-test (1)	Post-test (2)
Group	Mean Score	Mean Score	Mean Score
Masters	00 (0)	17.67 (1.63)	16.33 (0.39)
Non-Masters	9.57 (3.67)	9.50 (2.51)	10.60 (0.89)

Figures in parentheses indicate standard deviation

**TABLE 3**  
**Percentage of Masters and Non-masters in Multiplication  
 Before and after First and Second Remedial Teaching**

Remedial Teaching	Masters		Non-masters	
	Number	Percentage	Number	Percentage
Before first remedial teaching	Nil	0	14	100
After first remedial teaching and before second remedial teaching	06	42.86	08	57.11
After second remedial teaching	03	37.50	05	62.50

**TABLE 4**  
**Percentage of Masters and Non-masters in Multiplication in Terms of Boys and Girls Before and After First and Second Remedial Teaching**

Remedial Teaching	Masters				Non-Masters			
	Boys		Girls		Boys		Girls	
Before first remedial teaching	No. Nil	% 0	No. Nil	% 0	No 8	% 57 11	No 6	% 42 86
After first remedial and before second remedial teaching	5	62 50	1	16 66	3	37 50	5	83 33
After second remedial teaching	1	33 33	2	40	2	66 66	3	60

as multiplication competencies were concerned.

### Major Findings

- 1 Activity-based teaching in multiplication has enhanced learning achievement of Class II hearing-impaired children.
2. Solving word problems in multiplication was found to be difficult for hearing-impaired children irrespective of sex
- 3 Boys excel girls in acquiring mastery level in multiplication. This may be due to the poor addition skills of girls which is essential for acquiring skills in multiplication.
- 4 Hearing-impaired children were found to be more motivated towards activity-based teaching and gradually gained confidence through this approach.

### Educational Implications

1. The strategies used in this study to make children learn mathematics effectively should be of great help to the teachers who handle these children
2. Activity-based approach motivates children to learn better and hence leads to better achievement
3. It provides immense opportunities for the children in solving problems
4. This study may provide feedback to teachers to develop alternative remedial strategy and use it, if a set of activities fail to help the learners for better learning. In other words, the teachers may take up action research to find solutions to the problems encountered by them in their classrooms.

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# **Book Review**

## **Algorithms to Build a Better World**

*Computer Algorithms/C++*

HOROWITZ, SAHNI AND RAJASEKARAN

W.H. Freeman and Co., 1997, Reprinted by  
Galgotia, New Delhi, 1999

### **Become a Programmer and Improve the World**

There are many good reasons to become a programmer, the most important being that programmers routinely have the opportunity to IMPROVE THE WORLD. Find it hard to believe? Then consider visiting a bank that has not streamlined its functioning by adopting IT.

You will likely have to stand in several different queues for a simple transaction. At the end of each line, a clerk will take some information or documents from you, and enter something cryptic into a huge register or a file. Then you are off to another queue, waiting for a clerk to finish off with the customers in front of you. Probably you will be held up in at least one queue, because the clerk has decided to take a break, or has an argument with the customer right ahead of you. And God help you if you have to make a deposit, and withdraw some money, and open a term deposit ..

However, if you visit a "computerized"

bank, you will not face so many problems. Very likely, one teller, who has access to a terminal hooked up to the main computer of the bank, can handle all your work. Programmers are directly responsible for this incredible change for the better. This is one of the main reasons why programming is such a desirable activity.

Now if you wish to be a programmer, or you are involved in the education or training of programmers, should the book *Computer Algorithms* [HSR] be a part of your—or your student's—education?

The answer is Yes, with a Capital Y

In this paper, we have first given a reason for the importance of the subject of computer algorithms itself. Then we go on to indicate what we particularly like about this particular exposition of the subject. Finally, we conclude with a message for students and teachers who may be reading this article.

### **Two Kinds of Programmers**

There are two kinds of programmers. Let us decide to call them Type G and Type B. (These letters are meant to give a subtle message!) Type G programmers understand the importance of using the right data structures, and the right algorithms

in their program, and use them extensively. And Type B programmers' don't. In fact, Type B programmers don't know about the subject at all, and they get on quite happily with their lives. However, if they continue programming for several years, they may get lucky, and discover some of the algorithms present in HSR on their own.

Programmers who work at the systems level, or develop products, are forced to become Type G programmers. They make the operating systems (like Windows 2000) or software products such as Photoshop (an image editing software). Since the programs involved are huge, and require a large number of resources from the computer in order to function effectively, each component of the program has to be very efficient. Often, programmers in these companies will be involved in reading the latest papers written by scientists, and then translate their general instructions on how-to-do-something-in-nearly-linear-time into programs that actually work in nearly-linear time. At this time, it is imperative to be a little creative in choosing—or creating—the right data-structures, and in the design of algorithms. Here the techniques taught in (HSR) are particularly handy.

Indeed, [HSR] is merely the starting point for such programmers. Many of the references in [HSR] are needed on many occasions. At these times it is comforting to be able to refer to this book and understand the basic concepts involved before you move on to the technical references, which though informative, may be written in a different style. In short, the Type G programmers need the subject of Computer Algorithms, and quite likely already know this fact. And if you want to become

this kind of programmer, you may as well spend some time in studying this subject. Or, if you are an educator, responsible for the development of Type G programmers, you are advised to include the subject in your curriculum.

Programmers involved in application development (such as a system for a bank, or a web-application) often don't worry about the efficiency of their programs. Since the programmers operate in a very competitive market, the development time for such projects has to be very fast. Consequently, Type G programmers, who never let an opportunity pass to develop "Tools to Build Tools", have made some development tools designed to help programmers develop applications quickly. For example, one such tool is Visual Basic.

Visual Basic is a language (and a development tool), which is used widely to create the "Front End" of an application. At the "Back End" is a database, such as Oracle or SQL-Server. The end-user of the program interacts with the Front end, or the Graphic User Interface (GUI). The program interacts with the database. In some cases, the database and some of the business programs that interact with the database are kept at a different machine, called the server. The front end is kept at every user's machine (called the client). This kind of application, where there are many clients and a server is known as Client Server application. These programs also require the concept of "networking" so that the computers can talk to one another as required.

These applications can get very complicated, but they have one feature that allows for very quick development. Such



allows for very quick development. Such applications require the use of the same objects many times over. For example, buttons to allow a user to initiate a particular task or text-boxes to allow textual input behave pretty much the same way in each application. In addition, many of the tasks required of databases are also "standard." Thus, it was natural for programmers to design application development tools that allow the "re-use" of code quickly. These are visual environments, where a button can be dragged using a mouse and placed on a form. Most of the functionality of the button is predetermined, and the developer has to just select the functionality of their current button. In most cases, not much of "code" has to be written. It is merely selected and customized for the application in question.

When the entire code is compared with the parts that the developer has written on their own, it seems to be an insignificant portion. The types of programs mentioned in [HSR] seem far removed from the common programming tasks needed for application development. Thus, it is natural for application developers to disregard the subject of Computer Algorithms. They develop systems quite happily, and worry only a little bit about the performance of their systems. After all, computers will only become more powerful, and if the application seems to run a little slowly on today's slow PC, it will surely zip along on tomorrow's fast machines. Moreover, why do something that has been done to death before?

Not everything has, however, been done to death. In particular, the rise of the Internet has created many more opportu-

nities for programmers to discover and create brave new worlds.

For the creation of Internet systems, the critical factor to consider is the time taken for information to travel across the network. Web-designers insist that the display of the page should happen in less than one second. This is the amount of patience that people have been shown to demonstrate while browsing the web!

The importance of using efficient computational techniques will become clear if we consider a typical web-application. Let us take the example of the popular site called *amazon.com*.

Amazon.com is a bookstore on the web, where users can order from an amazingly large collection of books. The number of books that can be "displayed" on its bookshelves would likely require a store that is 10 stories high, and filled with books. Amazon is an amazing system. First of all, all the books and associated information about them (such as the title, author(s), publisher, price, availability, short description, longer reviews, and many other things) have to be stored in a data-base. The front-end, or the web-page that the user encounters when they land up at the site is designed to give several services to the prospective book buyer. For example, the book buyer should be able to browse the bookstore by Author or Subject. The book buyer should be able to search for a specific book. On the other hand, Amazon should show some books to every user, such as those that appear on the *New York Times* Bestseller list. Amazon also gives each user a "Cart" where they can place the books before buying. The user collects the books in this virtual cart,

the time of the sale, the system processes the payments (credit card payments only!) which involves connecting with a computer of the credit card union

In addition, amazon.com has added another very interesting set of features to its site. These are called "Cognitive Features" of a system. The essential idea to understand these design features is that they try to replace many useful attributes of the human salesperson present in a normal book-store. For example, suppose you frequent a bookstore often and always buy science fiction books. Now in the unlikely event of Isaac Asimov writing another book, you can bet that the alert salesperson will bring this book to your notice. Further, well-read booksellers will direct you to a popular science fiction thriller that has just been released and their other customers are buying

Amazon packs many such cognitive features on its site that involve adapting to a particular customer over a period of time, or of proactively generalizing by observing other buyers' behaviour.

Now if the potential book buyer makes a request at the website (whether it is to search for a book, or to buy a book) a small amount of information goes streaming to the server (or computer) where the Amazon site is maintained. This information is first broken into small pieces, that are later put back together by the server receiving the data. In response to this, the server may interact with a data-base, calculate an appropriate response, and send a page back to the user's computer, where it is displayed on the browser. Further, as we have noted, all this has to be done very fast. Since a large amount of time is spent in

processing and sending the data, web-programmers need to make any back-end processing as efficient as possible. The reasons for designing or choosing appropriate data structures and algorithms should now be clear.

Which systems will be successful? Obviously those that are packed with design features, and that also perform well where it comes to speed of download and processing. Given the massive rise of the Internet, and the scramble amongst companies to make every system web-enabled, most programmers will have to become web-programmers. Which web-programmers are going to be successful? Those who are forever trying to make the sites they develop faster, more efficient, and above all quick to download.

In short, Type G programmers will be the winners and Type B programmers the losers.

Nevertheless, if you have become—or, are in danger of becoming—a Type B programmer, don't panic: there is a remedy. And the remedy is to read the book [HSR], do the problems suggested by the authors, implement the algorithms they have reproduced, and try out the various approaches to algorithm dishing they have suggested. In less than three months, you will find yourself appreciating this book, and in a few years, will wonder how you lived without it. When that happens, you will wonder at how B you were, and how much better it feels to be so G!

### **What's so Special about the Book?**

Let us now assume that you wish to become a Type G programmer, and you realize that the Subject of Computer Algo-

gorithms is the way to go. But why read this particular exposition of the subject? After all, there are many books on the subject.

The reason is that this book is quite complete in its exposition, but still manages to be lighter (in weight) than many other books on the subject. And thanks to the Indian Edition, it is also cheaper. Here we indicate some other reasons to buy this book.

Typically, universities teach this subject to undergraduate students who have already some programming language, and who are fairly efficient in programming. Thus, students who take this subject have already struggled to make their programs work, and have likely already performed tasks such as searching for the smallest element in an array. Sure enough, the introductory chapter opens with precisely this example and gives an overview of the entire subject. What is interesting in the introduction (and the book) is that all aspects of the design and analysis of algorithms are touched upon, including the testing of performance and correctness by experimental means.

Another good feature of the book is that the code for many of the standard algorithms is given in C—or, as the authors claim, in C++. But not many features of C++ are used, so C programmers can understand most of the code. And if you decide to solve the problems of the book, you will get a lot of practice in C++.

The book introduces the central algorithms that people need all the time, such as sorting, searching and carrying out various operations on the most useful data structures. It also has a nice introduction to algorithms needed for multimedia (the

discrete fourier transform), networking, and for parallel computation. The suggested problems are chosen with care, and should form the backbone of any course taught using this book. These problems introduce all the central problems of computer science, that every programmer should be aware of. But more importantly, they give a nice introduction to how computer scientists think, and why they are interested in these problems.

Another neat idea of the authors is to organize the book according to the many strategies used to devise algorithms. While one or the other approach works best on any particular problem, the most interesting problems are those that can be approached in many different ways. As you read through the book, you begin to appreciate the thinking behind other programmers' hacks. Even though computers are primarily meant to communicate with computers, they can also give much joy to human beings.

There is one problem in taking (or teaching) a course which gives such a wide introduction to all the activities involved in the dosing, validation, analysis, and testing of algorithms. Many of these activities involve some heavy mathematics. In particular, the analysis of algorithms rests heavily in being efficient with working with recursions. In addition, there are frequent references to elementary number theory, linear algebra and abstract algebra. While these concepts are all fairly simple, and are treated nicely in [HSR], they do tend to add up. The student who is not familiar with most, or all of these ideas, is likely to spend most of the time grappling with them. The net result will be that the

other activities involved in the study of Algorithms will not get sufficient attention during the course.

For this reason, it may be a good idea to precede a course on Algorithms by a course on *Concrete Mathematics* from [GKP]. This book is somewhat expensive, but coming as it does from some of the greatest masters of this game, is well worth it. It will certainly ensure that the student learning to program better will be able to treat with some disdain the mathematics behind the computer science. This will allow students to work on getting at the central ideas of the subject, and to apply them to their own programs.

Despite this warning, it is a good idea that all the mathematics involved is given in this book. One does not want to shuffle between two books, written in two different styles, to understand one algorithm. Further, the mathematics will become real to most people only when seen in the context of problems faced by computer scientists.

### Concluding Remarks

Finally, we will conclude with a message for the students and teachers reading this paper.

First, dear students, do not worry too

much about whether you are "reading" the chapters, but concentrate on solving as many of the exercises and problems as possible. Try out the programs given in the text. There is no better way on the road to Programming Stardom.

And on the other side, dear lecturers, remember that it is not so important how well you teach the subject; what is important is that your students learn. So expend more energy in ensuring that all your students are doing the problems and are learning the subject.

And what after you have read the book and have managed to internalize its teachings? You can do no better than follow the advice of the most famous programmer of them all, namely, Bill Gates [G].

If you think you're a really good programmer, or if you want to challenge your knowledge, read the *Art of Computer Programming*, by Donald Knuth. Be sure to solve the problems.

Knuth's work is published by Addison-Wesley in three volumes, with more to come. The volumes are titled, *Fundamental Algorithms*, *Semi-Numerical Algorithms* and *Sorting & Searching*. If somebody is so brash that they think they know everything, Knuth will help them understand that the world is deep and complicated.

— GAURAV BHATNAGAR

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# Indian Education

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NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

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## Special Issue on Examination and Evaluation

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## About this Issue

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*It is a well established fact that freedom of expression provides life and sustenance to the functioning of all democratic societies and their institutions. This fact is particularly important in an institution like the National Council of Educational Research and Training which provides various forums to its faculty to express their free and frank opinions on different issues of academic and professional interest. Improving the achievement of students is an issue that is of paramount importance to all educators. Examinations and the process of evaluation play a vital role in it. This issue of the Journal of Indian Education, therefore, brings together a collection of papers that cover a wide range of concerns relating to examinations and evaluation in schools.*

*In order to give an opportunity to the Council's faculty to express its professional views on various issues of examination, evaluation and assessment, it was thought appropriate to bring out a special issue on examination and evaluation. Members of the faculty of the NCERT were approached to contribute on ten broad themes identified by the Department of Educational Measurement and Evaluation. The articles thus received have now been categorized in three broader themes namely concerns and innovations in evaluation, constructing quality tests for different purposes, and analysis and interpretation of test results for the purpose of their inclusion in the present issue.*

*It is hoped that the readers will find these contributions both purposeful and advantageous. However, the views expressed in these papers are the*

*personal views of the authors and do not necessarily reflect the official policy of the National Council of Educational Research and Training.*

*Dr Ved Prakash, Professor and Head, Department of Educational Measurement and Evaluation was assigned to coordinate this task and edit the issue. He was assisted by Dr Mamta Agrawal and Dr A. D Tewari. All of them deserve appreciation from me*

J. S. RAJPUT  
Director

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# Towards Quality Schools through Continuous and Comprehensive Evaluation

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## Abstract

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*The quality of a school is recognised by the standards of learning that the students achieve. Evaluation of student achievement thus plays an important role in making a school a quality school. Continuous and Comprehensive Evaluation can be the only effective scheme which can help keep tabs both on the levels of students' achievement in scholastic areas and their development in non-scholastic areas. It can help improve the quality of schools in a number of ways like using feedback of evaluation to improve the quality of not only learning but instruction and instructional material, improving the quality of tests; developing all round personality of students by taking into account the social-personal qualities, interests and attitudes; employing multiple techniques of evaluation including self and peer evaluation and maintaining meticulous records of different kinds of assessment. The present paper focuses on the need for thorough training of teachers and also involvement of administrators for the implementation of Continuous and Comprehensive Evaluation.*

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**Q**UALITY is the single most important issue in education today. We all recognise that there are problems with today's education. Students who come out of our school system are unprepared to meet the demands of society. Students who are not able to become responsible and productive citizens are a burden to society. These students are the product of an education system that focuses only on quantity and not on quality.

A paradigm shift can improve the quality of education. Old practices and beliefs must be questioned. A change has to be brought in today's school. To achieve quality education all the stakeholders of education must be committed to the transformation process of the school.

The quality of a school is recognised by the standards of learning that the students achieve. If the test scores are improving, it is obvious that the education must be improving. Measurement and evaluation of student achievement, thus, plays an important role in making a school a quality school just as its instructional programmes do. This fact can be observed in the characteristics of what Ronald Edmonds calls "effective schools". In his research on school improvement, Edmonds came out with five characteristics "which are the most tangible and indispensable" in effective schools. Out of these five characteristics two are mainly related to evaluation. They are described below.

1. Effective schools ensure that pupil progress is frequently monitored. They have the means whereby "the principal and the teachers remain constantly aware of pupil progress in relationship to instructional objectives."
2. Effective schools have "a climate of expectation in which no children are permitted to fall below minimum but efficacious levels of achievements." (Edmonds, 1979).

The other three characteristics outlined by Edmonds are concerned with strong administrative leadership which is to be provided by the principals, school atmosphere which should be conducive to the "instructional business at hand"; and instructional focus which means that the "pupil acquisition of basic school skills takes precedence over all other school activities."

Thus, apart from instruction and learning, evaluation also has been given a high weightage by Edmonds with reference to making a school effective.

In fact, one of the key components of the educational programme of a quality school is the development of an evaluation system which enables its teachers to keep tabs on the levels of its students' achievement and their personality development. Continuous and Comprehensive Evaluation (CCE) is the only effective scheme which takes into account and incorporates both the scholastic and non-scholastic aspects of

pupil growth. The National Policy on Education (NPE), 1986 also looks at student assessment as a device for bringing about "qualitative improvement in education". In order to streamline the evaluation at the school level and to reduce the predominance of external examinations, the National Policy on Education (NPE), 1986 and the Programme of Action (POA), 1992 suggest the introduction of "Continuous and Comprehensive Evaluation that incorporates both scholastic and non-scholastic aspects of education, spread over the total span of instructional time "

The present paper tries to make a case for continuous and comprehensive evaluation that can be employed as a powerful strategy for making our schools quality schools where quality education is imparted to make the students responsible and productive citizens of the country.

### **What is CCE ?**

Continuous and comprehensive evaluation is an approach that aims at assessing those attributes which cannot be assessed through one-attempt written examination. It also aims at making the students regular in studies. It provides enough flexibility and scope for promoting and assessing all round development of the child on a continuous basis which is not possible through the traditional evaluation system which is going on in our schools

There are three terms involved in the framework of continuous and comprehensive evaluation. These are 'continuous', 'comprehensive' and 'evaluation'.

The term 'continuous' refers to regularity in assessment. The growth of the child is a continuous process. Therefore, it should be evaluated continuously which means that evaluation has to be completely integrated with the teaching and learning process so that the progress of the students can be evaluated regularly and frequently.

The term 'comprehensive' refers to both the scholastic and non-scholastic areas of pupil growth. The function of the school is not only to build up the cognitive capacities of the child but also to develop his non-cognitive abilities. This obviously can be ensured when the evaluation is comprehensive. The comprehensive evaluation covers the whole range of student experience in the context of total school environment which includes aspects like physical, intellectual, emotional and social growth.

The third term is 'evaluation'. Evaluation is the process of finding out the extent to which the desired changes have taken place in the pupils. It, therefore, requires collection of evidences regarding growth or progress so that this information can be used for decision making. Thus, information gathering, judgement making and decision taking are the three phases of the process of evaluation.

With the above analysis, it is clear that continuous and comprehensive evaluation means a regular assessment of all the aspects of pupil development in the school.

### Characteristics of CCE

- 1 The purpose of CCE is mainly improvement in learning and diagnosis of weaknesses so that remedial measures can be provided.
2. Both the scholastic and non-scholastic aspects of pupil growth are evaluated through CCE.
- 3 CCE is informal evaluation in school carried out by the teachers who teach. The assumption is that the teacher knows his/her pupil well and that it is his/her right to evaluate them.
4. CCE provides for the use of multiple techniques of evaluation. These include not only written tests but also oral tests, observation techniques, interviews, practical tests, rating scales, inventories, schedules, profiles, etc.
- 5 CCE is built into the total teaching-learning programme and is a part of the daily routine for a teacher rather than being confined to a specific time in the year as is done in formal examinations.
6. CCE provides for the analysis and interpretation of evidence collected on three different levels

- (a) *Self reference i.e. with reference to the student himself* This indicates how the student is progressing, what the hard spots and the learning gaps are. This helps the learner to improve his/her learning.
- (b) *Criterion-referenced, i.e. with reference to the criteria set by the teacher* The teacher finds out whether the student has attained the expected level of performance or not. This is in keeping with the idea of minimum levels of learning (MIL) wherein the curriculum is defined in terms of achievable competencies. The minimum achievement level is supposed to be 80 per cent wherein those with 80 per cent may be termed as masters and those below 80 per cent as non-masters. The non-masters need to be given remedial instruction so as to bring them at par with their counterparts.
- (c) *Norm-referenced, i.e. with reference to the peer group.* This indicates a student's position with reference to his/her class. The performance of a student can be compared with the performance of other children in the class. This motivates the children to do better.



## **How Can CCE Improve the Quality of Schools?**

Evaluation is recognised as a "powerful, low cost means of influencing the quality of what teachers teach and what students learn in schools" (Heyneman and Ransom, 1990) In our country, inexpensive means of improving the quality of education are all the more needed as there are more children to be educated and less money to educate them with. The continuous and comprehensive evaluation system can be utilised fruitfully to bring about qualitative change in our schools.

It is a well known fact that what is tested is taught in schools. It is because of this reason that the public examination held at the Class X level dictates what is to be taught and how it is to be taught at lower levels of education. The total evaluation as well as the teaching system in our elementary schools has been cast in the same design as the secondary level because of the public examination in which it culminates.

This psychology of students and teachers that what is tested is to be taught and learnt in school, has to be used in a positive manner in schools, if the quality of learning is to be improved. CCE can play a leading role in this. 'How' is the big question. It can be done in a number of ways.

## **CCE and Improvement in Learning and Instruction**

The purpose of CCE is to improve learning by making evaluation an integral part of the teaching-learning process.

Evaluation of pupil progress contributes directly to improve pupil learning in a number of ways. The evaluation procedures used help clarify for the pupil what it is that the teacher wishes him to learn. Feedback from the evaluation provides him with concrete information about his progress. It also indicates his readiness for future learning activities. Through the continuous evaluation, the teacher knows the extent of learning at every stage. If there are any hard spots or gaps in learning, appropriate remediation can be provided. For students who show good progress, enrichment measures can be initiated. Thus, continuous evaluation helps in improving learning through diagnosis and remediation. It enables the teacher to keep a continuous and regular watch on the pupil development.

Not only is learning improved through CCE, instruction is also improved. The feedback from evaluation procedures not only acts as a guide for the teacher for selection of future learning experiences, but also encourages him/her to have a fresh look at the appropriateness of his/her teaching strat-

egies. Many a time it is the evaluation that prompts a teacher to change his method of teaching. Furthermore, the information from a carefully designed evaluation technique can provide the teacher with clues to the effectiveness of the course content and is also useful in making judgement as to the appropriateness and feasibility of the previously determined objectives for the course. Thus, evaluation procedures contribute to the evaluation of the teaching-learning process itself, as well as contribute directly to improved pupil learning (Gronlund, 1966)

### CCE and the Quality of Tests

Public examinations have been a focus of criticism for a long time. Talking about these, Buckle and Riding (1988) wrote that through these examinations "the candidates' work, over a substantial period of time and range of content, is assessed by his or her performance on a small sample of the course in a short period of time. Typically, the time devoted to assessment may be one per cent or less of the time which the candidate has spent studying the course. Short written examinations are limited in the skills which can be tested in addition to the problem of amount of content which they can include "

Buckle and Riding further add that such examinations lead "to an emphasis on content-dominated, lower level intellectual skills with a predominance of verbatim learning" "To what extent are

such examination results a valid representation of the individual's educational experience and achievement?" they question. The answer lies undoubtedly in the school based continuous and comprehensive evaluation system. All these shortcomings of public examinations can be easily taken care of if the schools take up CCE according to which the students will be evaluated more frequently leading to the assessment of their performance on a larger area of course content. If the tests are given after teaching each unit, all the course content will be covered automatically.

Through CCE, not only can the entire course content be covered, but also meta-cognitive abilities evaluated which get neglected by the one-shot examination. The subtle details involved in the higher level mental skills are not revealed in such an examination. In a unit test, however, it can be easily ensured that application and problem-solving questions are also included which test the students' critical thinking wherein the abilities of analysing, examining, justifying and judgement making are tested. Thus, the testing in CCE becomes more valid not only contentwise but objectivewise too, as higher objectives of teaching are also covered. If the teachers of a school are trained in developing balanced tests wherein appropriate weightages are given to different objectives like knowledge, understanding, application and skill, and they prepare better quality tests for testing their

students, the learning standards of that school will certainly improve. The students of such a school will learn from the beginning to classify, compare and contrast, to establish relationship, to interpret, to solve problems, to think critically and logically, to analyse situations, to arrive at a conclusion and to make judgement. Such skills will go a long way in making these students productive and useful citizens of the nation. If such a school is not a quality school, then which one is?

### **CCE and All Round Development of Personality**

The prime concern of education is to bring about an all round development of human personality. In today's world the development of intellectual powers is not enough. The development of social intelligence, emotional intelligence and physical aspects of personality is also as vital as the development of mental intelligence. The traditional school system works only for the development of the cognitive domain of the human personality. The development of both cognitive and non-cognitive capacities of students can be ensured only when a school takes up the system of CCE. The comprehensive evaluation takes into cognizance the learning outcomes of both these domains. The scheme of assessment of non-scholastic areas as envisaged by Arora and Agrawal, (1993) is as follows

### **What Can Be Tested?**

#### *Personal and Social Qualities*

- cleanliness
- truthfulness
- industriousness
- equality
- cooperation
- regularity
- discipline
- spirit of social service
- initiative
- emotional stability

#### *Interests*

- literary
- scientific
- musical
- artistic
- social service
- sports and games

#### *Physical Health*

#### *Attitudes*

- towards teachers
- towards studies
- towards schoolmates
- towards school property
- towards school programmes

#### *Values*

- socially accepted values

#### *Co-curricular Activities*

- Scouts/ Guides
- dance, drama, music
- drawing and painting
- debate, quiz
- creative writing

- games and sports

#### *Work Experience Activities*

- gardening
- carpentry
- chalk/candle making
- sewing
- arts and crafts
- book binding

#### *Techniques of Evaluation*

- observation
- interview
- rating scales
- anecdotal records
- medical check-up for physical health

#### *Periodicity*

- day-to-day observation by the teacher
- reporting once every term
- annual medical check-up

The framework suggests that the assessment of non-scholastic areas should be indicated in terms of letter grades in the report cards of the students.

A school may select any four or five qualities from the given list of social-personal qualities to be developed and assessed. The teacher has to collect evidence for the selected qualities through observation and interview. Students should be observed for these qualities not only in the class but also outside the class, in the play field and even outside the school. The opinions of other teachers and even the students can be taken about the behaviour of a student.

Regarding co-curricular activities and work-experience activities, every stu-

dent may select one activity in each. A school which assesses its students on such activities has to provide ample opportunities for the students to learn them properly.

The evaluation of non-scholastic areas, as observed by Agrawal, "not only brings to light the hidden qualities in children, but also prepares them for the future. There are certain traits, qualities, attitudes and values which are needed by an individual for success in life. For example, qualities of regularity, punctuality, discipline, initiative, industriousness and cooperation are valued in professional life; qualities of respect for others, truthfulness, emotional stability are required for a happy personal life."

A quality school should make conscious efforts to develop these aspects of personality in students. The study carried out by Rajput and Agrawal shows that the assessment of non-scholastic areas helps to draw out the best in the child. Some children who are not high achievers in scholastic areas, are able to shine in drawing, painting, dance, music, drama, or sports if these areas are given due importance by the school.

Not only does the assessment of non-scholastic areas help to bring the weak students out of their shells, it helps to relax the atmosphere of the school. The interpersonal relationship between the teacher and the students is more informal and children are free from the stress which is generated due to the formal testing and examination system.

Another reason why it is important for teachers to know about the students' attitudes, interests, values and general make up is that this knowledge can be used to remove their learning difficulties and enhance their academic achievements. Quite frequently, learning difficulties are related to a student's personality (Edwards, 1977). They are influenced by the student's attitudes, values, and interests. If a teacher knows that Sachin likes sports, she might have him read sports magazines in order to help him improve his reading. Thus the teacher can capitalise on the interests and attitudes of the pupils. However, before teachers can use the data about the affective variables, they must obtain the data (Mehrens and Lehmann, 1987).

Regarding the students' achievement in non-cognitive areas Nevo points out, "A school can take not only in its students, test scores on national assessment programme, but also in their accomplishments on regional, national or international competitions and contests. Such competitions may be in academic areas such as science, geography or writing or in non-academic areas such as sports and music. Such accomplishments usually belong to a relatively small group of students, but they can nevertheless tell us something about the school's priorities and efforts. Some schools are proud of their students' achievements in sports, and in certain societies more than in others, such achievements are considered to be indicators of school quality."

### **CCE and Techniques of Assessment**

CCE allows for the use of multiple techniques of evaluation. As Brown and Knight put it, "Multiple methods are best." According to them the simplest ways of swiftly improving the reliability of assessment is to use more than one method to assess an achievement and to use more than one assessor—one of the assessors may be the student-as-self-assessor, or another student (Brown and Knight, 1994).

In a traditional evaluation system students are assessed mainly by the teachers for their achievement with little regard for the process involved. The CCE, which in essence is formative evaluation, allows for evaluating students' processes of learning also apart from their achievement, which is very useful in providing feedback for improvement. "Even very specific information on student achievements may not show how to improve them unless the learning activities that led to these achievements are examined. To do so we must observe the learning process and try to relate it to student achievement" (Nevo 1995).

For assessing the process of learning it is important to involve the learners in the assessment of their own work. While the assessment of products is very often best undertaken by a third person, assessment of process necessarily involves those involved in that process. Self-evaluation is important because students will be expected to practise it in every area of life after they graduate from

school. Moreover, self and peer assessment enables learners to develop their own personal skills such as group work, leadership, team work, creative thinking and problem solving. This tends to motivate students who feel they have a greater investment in what they are doing (Brown and Knights, 1994). Self appraisal also helps increase pupils' awareness of their strengths, weaknesses, opportunities and threats which in turn not only enhances their motivation but also their personal development.

Apart from self and peer-evaluation, CCE also calls for employing a variety of techniques for assessing student performance and keeping a record of it. The record of achievement is a vehicle that schools can use to organise the different kinds of assessment like pupils' achievement in written tests, teachers' observation of their day-to-day behaviour, their performance on oral and practical tests of various skills, anecdotal records, ratings on various rating scales apart from their self appraisal and peer evaluation. Such a record may finally culminate in a report card or certificate which is a summary document regarding the student's achievement and growth in different areas. Such a document may be a source of pride for the young school leavers and will be valued by potential users for the wide picture of a young person's qualities and achievements that it portrays (Broadfoot, 1992).

The present paper has suggested how the implementation of continuous and

comprehensive evaluation can result in making schools quality schools. It has argued for making evaluation an integral part of the teaching-learning process and using its feedback not only to improve the standard of student achievement but also to improve the quality of teaching in schools. It has also suggested that evaluation should not stick only to scholastic aspects of pupil growth but also take into its fold the non-scholastic areas of human personality so as to bring about an all round development of students. The evaluation scheme that a school carries out to assess its students is a very potential indicator of its quality. David Nevo also puts a high premium on student achievement as a very important indicator of the quality of a school apart from other indicators when he makes a case for school based evaluation for improving schools.

However, there are some peripheral problems which need to be sorted out before the schools in India can implement the CCE scheme. The study carried out by Rajput and Agrawal clearly indicate that greater involvement of the school administration was required in its implementation. Unless the guidelines are prepared and circulated to schools, the schools will not do it on their own. Similarly, orientation of the principals of schools is needed because it is they who organise and manage evaluation in school.

The teachers also will need a thorough training in CCE, especially

in the assessment of non-scholastic areas. They should be trained in using various techniques of evaluation and in recording the evidences collected through them. Once all this infrastructure is ready, our schools will take no time in becoming quality schools.

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# Beyond Testing

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## Abstract

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*The present classroom assessment practices are based mainly on testing. Tests, whether standardised or teacher made, generally test a student's ability to recall factual knowledge. However, the objective of science teaching is not only to impart knowledge to pupils but to develop the scientific attitude, the spirit of enquiry, moral commitment to conscientious citizenship along with the mastery of subject matter which cannot be evaluated through traditional tests. To assess such objectives of science such as conceptual change, attitudinal change, and observational and enquiry skills, assessment procedures other than tests need to be used. These include concept maps, observation records, attitude scales, etc. Researchers have found that these tools are fairly valid and functional in classrooms. The present paper discusses how these recent techniques can be successfully used in the classroom.*

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**A**SSessment is an integral part of the teaching-learning process. The classroom teaching-learning processes greatly influence the assessment procedures and vice-versa. Science is taught in our schools as a body of facts, laws and formulas. Didactic methods of teaching are used to teach science. These include teacher talk, reading textbook, writing questions and answers on the blackboard, demonstrating experiments/activities, etc. The learning process consists of memorising facts, laws, rules, formulas, drilling exercises and assimilation of known content. The assessment procedures accordingly include giving tests, asking factual questions and correcting students' errors. The emphasis in the total teaching-learning process is on giving new factual information to the students. Students are expected to memorise and reproduce this information in the examinations. These methods of teaching and assessing science learning ignore the basic nature of science and the objectives of science teaching. The process-objectives of science teaching include observational and enquiry skills, experimentation, hypothesis formulation, predicting and explaining natural phenomenon, recording and interpreting data, etc. The product objectives of science teaching include conceptual change, attitudinal change, mastery of concepts and their application. Science curriculum should help children in producing knowledge, that is, constructing and

articulating their own ideas. Science teaching should focus on eliciting children's ideas, solving problems, debating and making sense of discrepant events. The classroom assessment procedures, therefore, should include such tools and techniques which help in measuring these objectives of science teaching.

### Assessing Conceptual Change

Driver (1986), Posner (1982) and Novak (1993) conducted a number of studies on 'how children learn science'. They believe that students come to class with a number of pre-concepts. The empirical data suggest that when children encounter new information, they use their own prior knowledge and personal experience to make sense of the new material. During meaning making process, they reformulate the new information, restructure their existing knowledge and reorganise their prior conceptual schemes. These researches also indicate that classroom interaction facilitates conceptual change (Posner, Strike, Novak 1983, Driver, 1987). However, measuring conceptual change is particularly difficult because quantification of this process of conceptual change poses problems for teachers. Techniques which can be used to assess conceptual change include concept mapping and Venn diagrams, portfolios and performance-based tests. Concept mapping and Venn diagrams are particularly useful during the teaching-learning process, i.e. formative evaluation.

### Concept Maps as Assessment Tools

Concept mapping is a powerful learning and assessment tool. It was developed as a strategy to probe knowledge structures of learners and is now also used to assess students' understanding of concepts (Horton, 1993, Novak, 1990). During the process of construction of concept maps, learners think about related concepts, graphically draw the relationship between concepts/terms etc. This facilitates the understanding of science concepts. A comparison of pre-instructional and post-instructional concept maps of students indicates the conceptual change and understanding of science concepts. Teachers can assess the prior knowledge of students with the help of concept maps and can also use these for lesson planning. This also helps students to internalise their understanding of concepts (Edwards and Fraser, 1983, Rye, 1995, White and Gunstone, 1992). Teachers can use concept maps as advanced organisers and as post-instructional knowledge assessment tools (Novak and Gowin, 1984). Concept maps can also be used as study tools and self-assessment tools by students because they allow students to critically assess their own understanding. Since concept mapping is a relatively new idea for teachers and teacher educators, it is important to discuss how teachers can teach and help students to construct concept maps.

### Construction of Concept Maps

Concept maps represent an individual's understanding of related concepts. These maps generally have a hierarchical structure, working downwards from general concepts to more specific ideas with appropriate relationship linkages along the way. For the beginner students, teachers can list the concepts and ask the students to draw linkages between these concepts. But, when students have learnt to draw the concept maps, they themselves can list and cluster the concepts for a given topic. Concept maps can be drawn by students independently or in groups. The mechanism of concept mapping involves the following steps.

1. *Identify the concepts.* Identify, select and list the concepts that students believe are important to understand the 'topic'. For example, to understand the topic, 'Air Pollution', environment, composition of air, smoke, carbon dioxide, oxygen, home waste, vehicles, plants, animals, etc. can be listed.
2. *Group the concepts in hierarchical order.* Place the most general concept at the top, working downwards to more specific concepts. For example, environment, composition of air, pollutants, home wastes, trees, animal are more general concepts, whereas carbon monoxide, carbon dioxide, oxygen are more specific concepts.

- 3 *Draw linkages/relationships between general concepts and specific concepts*  
Cross-linkage between different concepts and sub concepts can also be drawn. Linking words can be verbs, prepositions and conjunctions that describe the relationship between two linked concepts/terms
- 4 *Cross-link other relevant relationships*  
Cross links represent the relationship between two linked concepts/terms
5. *Study your maps and see what meaning it conveys to you* Try to make horizontal rather than vertical branches if the linkage string of concepts is long.

The skill of concept mapping must be learnt by all students. To begin with, students can start with familiar concepts. As students draw more and more concepts, this becomes a creative art for students. To use these concept maps as assessment tools, teachers must help students to draw expanded maps.

### Assessment Using Concept Maps

Consider the concept maps shown in Fig 1 and Fig. 2 drawn by a student of Class V. Fig. 1 shows the pre-instructional concept map and Fig. 2 the post-instructional concept map by the same student.

#### *Scoring of Concept Maps*

Pre-instructional concepts are not graded. These are used only to share students' existing concepts with teachers and peers. Post-instructional concept

maps can be scored using a scoring scheme developed by the teacher. The scoring plan should provide for multiple levels of achievement (Jensen, 1995). The scoring scheme for concept maps must contain the following criteria parameters:

1. *Number of relevant concepts:* The teacher must see that the student has listed a majority of the relevant concepts. The number of relevant concepts are counted and weighed according to their degree of inclusiveness. For example, in the broader concept of environment, composition of air gets more points compared to fire or home wastes.
2. *Number of valid propositions:* This parameter is particularly useful in the assessment of concept maps. Each proposition should be carefully checked by the teacher for its validity. The proposition represents the relationship between two concepts. Concept map should be examined for appropriateness or otherwise of the proposition. Propositions, too, can be weighed according to the degree of importance of relationship that these prescribe.
3. *Number of cross-links:* This parameter indicates the degree of integrative, meaningful connections between concepts in vertical and horizontal segments. The number of cross-links can be weighed according to their importance.

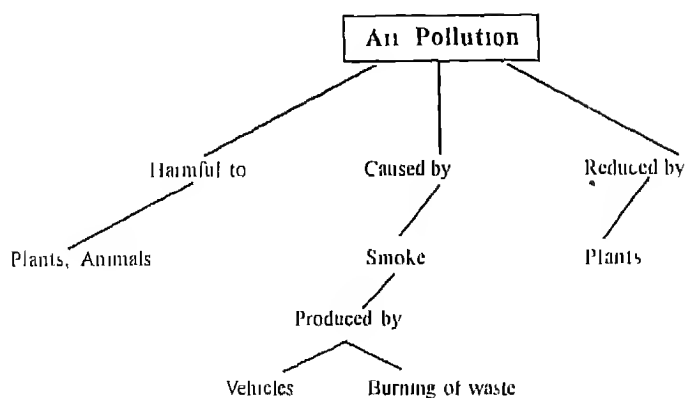


Fig 1 Pre-instructional Concept Map by a Class I student

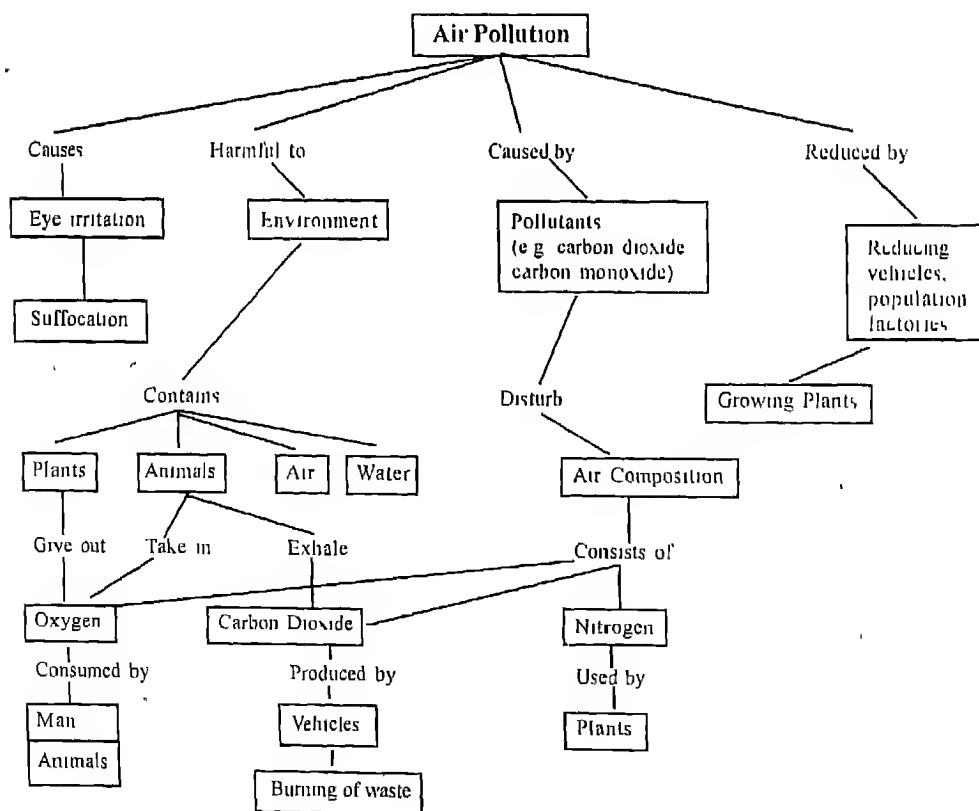


Fig 2 Post-instructional Concept Map by a Class I student

- 4 *Branching* This parameter represents the progressive differentiation of concepts. Branching involves linking concepts at one level to concepts at a different level, i.e. linking higher level concepts to lower level concepts in different ways. Branching can be vertical and also horizontal. Branching can also be weighed for its importance and appropriateness.
5. *Number of examples of specific concepts:* Students can illustrate specific concepts giving examples. These examples also help in assessing the student's understanding of the concepts. These examples can be assessed as events, objects, classes, etc.

Concept maps can also be used for diagnosing misconceptions. Consider the concept map given in Fig.3

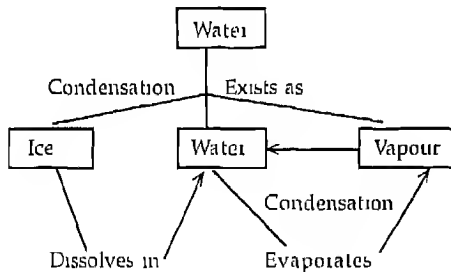


Fig. 3

Now, if we check the misconceptions in this map, the first is that ice dissolves in water. The student's observation was that when ice is added to water in a glass, the ice disappears. The student's conception is that ice mixes completely with water and therefore, dissolves in it. The student does not know the con-

cept that ice melts into water. Concept maps thus help in identifying students' misconceptions.

### Assessing Attitudinal Change

One of the major objectives of science teaching is to develop the scientific attitude among pupils. However, such affective objectives are completely missing in our teaching-learning and assessment procedures. One of the reasons for this neglect is that affective attainment has not been defined in operational terms in our curriculum. Attitudinal changes should also be stated in terms of behaviours that can be observed and measured. Although the taxonomy of affective behaviours was developed by Krathwohl and others, its application and use in the school curriculum is insignificant compared to Bloom's taxonomy and cognitive objectives. This taxonomy is complex, difficult for teachers to recognise and apply, but it can be simplified by the teachers for their own use. To illustrate this, let us examine the five levels suggested in this taxonomy.

- (i) Receiving or attending
- (ii) Responding
- (iii) Valuing
- (iv) Organisation of values
- (v) Characterisation

In this classification, categories (i) and (ii) are related to simply receiving an educational experience, whereas categories (iii) to (v) are concerned with adoption of values. Each main category

can be divided into sub-levels, using the principles of internalisation as suggested below.

*Level 1: Reception of an Educational Experience*

1.1 *Awareness*: It is the lowest level where the pupil is simply conscious of the educational activity.

1.2 *Willingness to receive*: The pupil is not only aware that something is going on, he/she is willing to submit to it without coercion

1.3 *Controlled attention* The pupil is not only willing to give his/her attention, he/she also discriminates between various experiences and exercises preference of one over the other.

*Level 2 Responding to an Educational Experience*

2.1 *Responding only* The pupil pays attention and responds to the educational experience. This response is treated as obedience and compliance, and not self motivated response

2.2 *Willingness to Respond*: This response is voluntary, self motivated and not merely obedience

2.3 *Satisfaction in Responding*: Pupil responds more positively and finds satisfaction in it.

The important and practical question for a teacher is *how to translate these into operational terms* This can be illustrated using a simple topic on 'Road Safety' for Class V.

The affective objectives of this topic can be defined in operational terms as follows.

*Level 1 1*: The pupil is aware that there are road safety regulations.

*Level 1.2*: He/she is willing to read them, and wants to be told about them.

*Level 1.3*. He/she accepts the importance of these safety rules and knows some of these rules. He/she may not respond to these regulations.

*Level 2 1* He/she obeys road safety rules only when reminded that disobedience of these rules may put him/her in trouble.

*Level 2.2*: He/she willingly complies with road safety regulations and obeys them even if he/she were not under supervision.

*Level 2.3*. He/she prefers to follow the route where safety rules are observed. He/she has a positive attitude towards road safety rules and values these.

The students are said to have developed a positive attitude when they have internalised the experience and have adopted this as a way of life. The next important question is *how can teachers assess this attitudinal change*, that is, have students adopted the scientific way of life or not?

**Techniques of Attitude Assessment**

The most commonly used and accepted technique for attitude assessment is observation Other procedures of assessing attitudinal change include open-

ended and structured interview and written tests.

Observational techniques are based on direct observation of pupil behaviour by the teachers. These are considered more reliable and valid compared to interviews or written tests. For example, in the interview, the child may say that he obeys the road safety rules but in practice he does not. Direct observation by the teacher may reveal that in practice he disobeys and disregards safety rules. The teacher can record and quantify his observations in the form of rating scales and checklists.

*Check List for Attitude towards  
Road Safety Regulations*

	Yes/No
1. Plays on the road	
2. Plays on the footpath	
3. Crosses road at red signal only.	
4. Crosses road when signal is green.	
5. Crosses road at zebra crossing only.	
6. While crossing road looks to right, then left, again right and then carefully crosses the road	
7. Tells friends not to play on the road	
8. Drives cycle in cycle lane	
9. Shows indifferent attitude when other children play on road	
10. Walks on the road	

*Rating Scale for Attitude  
towards Science*

Rating scales can be bipolar, from negative to positive rating through zero as neutral response. Rating scales can be

weighted, such as weightage 1 to 5 given to five responses A,B,C,D and E. Rating can also be in terms of agree (5) to disagree (1). The quantification depends on the nature of attitude to be assessed. For example, the attitude towards science can be assessed on a scale with ratings from negative to positive through zero (-2 to +2). To illustrate, the rating scale can contain items such as

1. is constructive	.. is destructive
2. is useful	.. is harmful
3. uplifts economy	.. fails economy
4. fights diseases	.. spreads diseases
5. builds peace	.. destroys peace
6. is objective	.. is subjective
7. is universal	.. is local
8. improves quality of life	.. lowers quality of life
9. cleans environment	.. pollutes environment
10. is practical	.. is abstract

To assess the attitudinal change, the teacher can use rating scales with parallel items before and after instruction.

### Open-ended Interviews

Open-ended interviews start with teachers building informal contacts with students. Through informal discussions in and out of class, the teacher comes to know about students' likes, dislikes, opinions and attitudes. Next, the teacher starts asking open-ended questions, where students are allowed free response. The advantage of open-ended

interviews is that students themselves express their attitudes and their responses are not restricted to Yes/No answers. The open-ended interviews are assessed subjectively and their validity and reliability are generally low.

### Structured Interviews

Structured interviews can be conducted individually or in groups. Responses are more objective in structured interviews because workings of the questions are exact and pointed so that each question elicits only one or two points. The advantage of structured interviews is that these can be scored more objectively. Teachers sometimes find construction of structured interviews more difficult compared to open-ended interviews. Written tests of attitudes have not been found functional at the primary stage.

### Assessing Observational and Enquiry Skills

Observational and enquiry skills are important process objectives in science which are helpful in achieving higher order product objectives such as ability for independent thinking and knowledge construction. In science, each lesson must start with students' prior knowledge, their prior experiences, observations and questions. Students must be encouraged to raise queries, design experiments and find solutions. The assessment procedures, accordingly, should have provision for assessing their observational and enquiry skills. One of the most useful tools in assessing

students' observational skills is their record of observations. Each student should develop the habit of recording his observations truthfully and of maintaining the record of observations. The students' record of observations can be scored like a student response test (oral and written). This tool is mainly used to evaluate observational skills and the ability to classify and record data. For example, students may develop the observational record to understand the concept of shadow. These can be used to assess the observational skills of students.

*Example 1:* Observe the shadow of a tree near your house or in your school garden at different times.

*Time* 6 00 A M, 9 00 A M, 11 00 A M, 12 00 Noon, 1 00 P M, 3 00 P M, 5 00 P M, 6 00 P M,

*Direction*

*Length*

*Example 2 :* To understand the life processes, the following observation record can be developed by students

S No	Life Process	Rose	Neem	Cat	Butterfly
1.	Grows				
2.	Moves				
3.	Lays eggs				
4.	Has seeds				
5.	Bears flowers				
6.	Needs food				
7.	Needs sunlight				



In order to develop enquiry skills, students should be encouraged to find solutions to everyday problems. They should also be encouraged to design experiments and discuss their points with others or in groups. For example, to light a bulb, why is it necessary to connect a bulb through a wire to both ends of the battery? Or, why do plants bend towards light when placed near a window? Similarly, why don't seeds germinate when completely immersed in water. Students' responses are scored for their ability to formulate problems, formulate and state hypotheses, design experiments, and draw inferences. These should not be evaluated as right or wrong. Students should be allowed to reason with and provide explanations

### Recording Students' Assessment

Classroom assessment aims at improving the teaching-learning process. Since the teaching-learning process is still fluid, these assessments should not be used for purposes of classification or promotion. Taking this formative view

of evaluation the recording should be done in terms of specific 'remarks' or 'comments', that is, what a student should do/try in order to learn the desired competency. Marks and grades do not convey much meaning to these students and students of primary classes also find it difficult to interpret these in relative terms. If a student is given say, grade 'C' on two or three occasions, she/he may develop the feeling that her/his grade is 'C' and will remain 'C' but actually, this is a process of learning and the student's achievement may be higher at the end. Specific remarks such as 'good', 'very good' may be used for reinforcement but 'poor', 'weak', etc. should be avoided and translated in terms of specific errors.

Assessment at the primary level and particularly in science puts additional demands on teachers in terms of effort and time. The teacher has to be innovative and creative to design a variety of tools for classroom assessment. Pupil participation in the assessment process is important.

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# Innovative Practices in Students' Evaluation

## An Overview

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### Abstract

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*Examination reforms have always offered a prolific field for innovations. Education Commissions (1949, 1954, 1966), Committees on Examinations (1970, 1981, 1986) and Education Policies (1968, 1986 and revised in 1992) together with their implementation strategies have equivocally advocated the need for reforms in examination, and evaluation of students' performance. A number of innovative practices have been suggested and practised at various levels in the past*

*In the present paper, an attempt has been made to present an overview of innovative practices introduced in school evaluation for improving the evaluation tools, types, techniques and framework of evaluation, reporting of evaluation results and management of examinations. In the end, the prospective areas of students' evaluation requiring innovations have been identified as assessment of pupils' growth and development specifically in non-cognitive areas, conduct of achievement surveys, use of mechanical devices and electronic aids in educational evaluation, establishment of National Testing Organisation, on-line testing, grading and the semester system.*

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**A**LMOST fifty years ago the University Education Commission (1949) observed, "For nearly half a century, examinations, as they have been functioning, have been recognised as one of the worst features of Indian education". The Commission was of the view, "If examinations are necessary, a thorough reform of these is still more necessary"

Almost similar views have been expressed by subsequent committees and commissions appointed after it for the purpose of reforming education in general and students' evaluation in particular in the country. Student evaluation has not changed qualitatively as expected even after experimenting with many reforms and innovations in the field. While discussing the issue of evaluation processes and examination reforms, the revised Programme of Action, 1992 of the National Policy on Education observed, "Reforms in examinations have been a subject of serious discussion for long. Some changes have been introduced in the system at the initiative of NCERT in school examination and the University Grants Commission (UGC) in the University level examination. On the whole, however, the impact of these reforms though satisfactory could not ensure solid foundation to the concept of educational evaluation". This scenario has further been verified by the observations made in the discussion document on National Curriculum Framework for School Education, 1999, by pointing out,

"Several efforts have been made to reform the examination system but the success rate has been far from the expected. The public examination at the terminal stage of education, which we inherited as a legacy of British rule continues to dominate the Indian scene and the system of examination and evaluation seems to have eroded the confidence of the people".

### Agencies of Innovation

Examinations were not the same at the beginning of the formal system of education, as they are today. These have undergone frequent changes. These changes were introduced to reform the examination system by way of introducing innovations to improve upon some aspect or the other of the system which has somewhat changed the complexion of the examinations from the one being used at the formative stage. These innovations have been introduced at the initiation of NCERT with a view to providing a sound theoretical framework to the concept of evaluation at the school stage. Some others have come as a result of the efforts made by Boards of School Education with a view to conducting and managing examinations smoothly and flawlessly. Still some more innovations trickled down to the school education system from the tertiary level of education and have been encouraged by the University Grants Commission to improve evaluation at the higher education level.

These innovations, undertaken in the past, have been broadly divided into six categories of innovations: (i) tools of evaluation, (ii) types of evaluation, (iii) techniques of evaluation, (iv) framework of evaluation, (v) reporting of evaluation results, and (vi) management of examinations. These are presented in a schematic diagram on the next page. A brief description of each of the innovations has been given below.

### **Innovations to Improve Tools of Evaluation**

To improve upon the tools of evaluation, innovations in the form of objective type test, balanced question paper, unit test, question bank, model question paper and optional questions were undertaken during the last five decades. These innovations have been briefly discussed below.

#### *Objective Type Test*

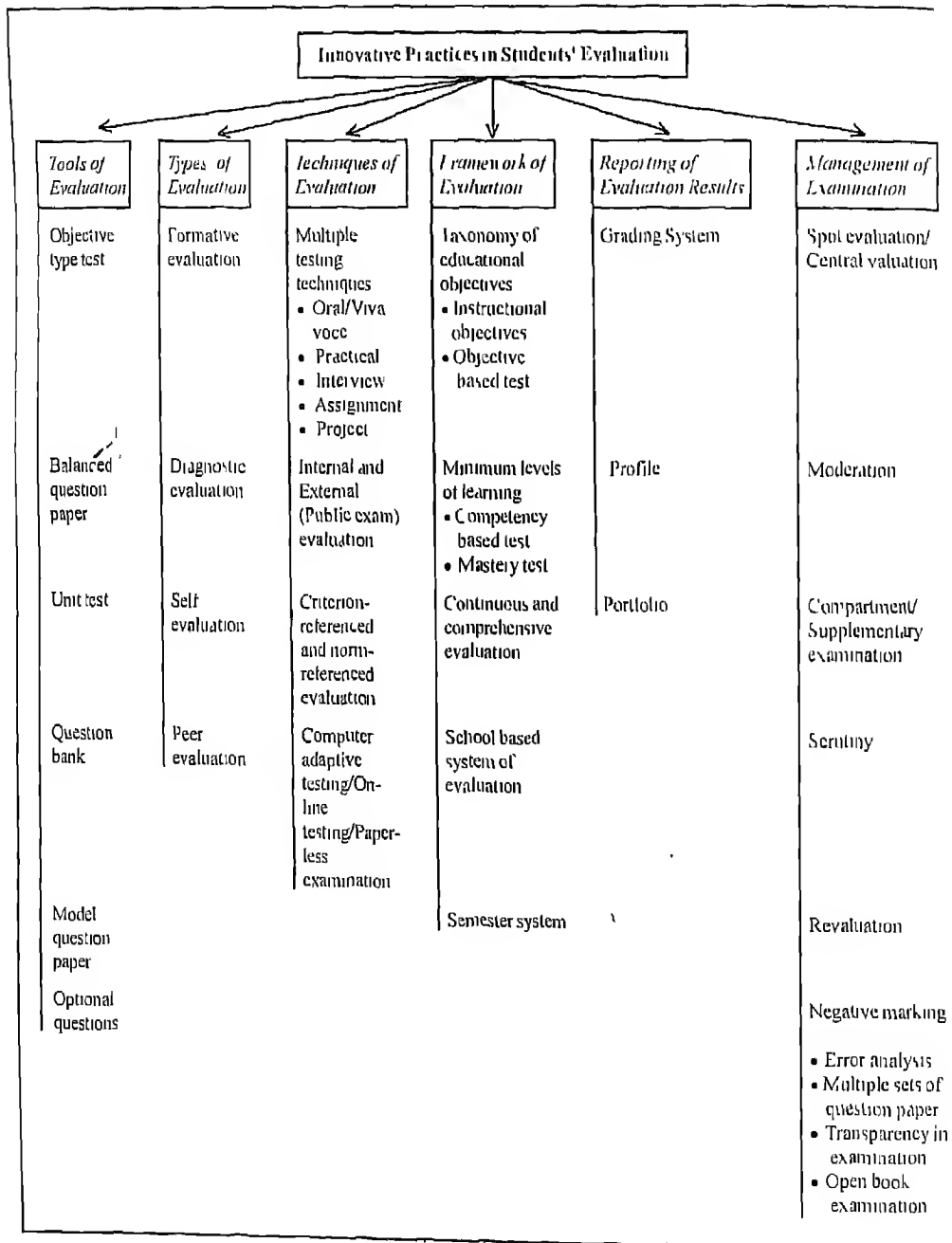
A test characterized by fixed response format and predetermined scoring key is known as objective type test. It enables one to make any judgement free from personal bias. Objective type tests are the result of the attempt to minimise the subjectivity aspect of essay type tests that dominate the school education scene. Objective type tests belong to the category of fixed response type tests. These are either selection type (correct answer is selected) or supply type (correct answer is supplied). Matching, multiple choice and alternate response type

are the three selection type tests, whereas completion type and fill-in-the-blanks type test are the supply type tests. Use of multiple choice type tests is mostly preferred in schools to measure even higher mental abilities and for assessment purposes in other sectors.

#### *Balanced Question Paper*

Development of a balanced question paper is an innovation initiated by the NCERT and adopted by most of the School Boards of Education. In this, proper care is taken to assess students' achievement with paper-pencil type (written) test. Design, blueprint and detailed marking scheme are the three components of a balanced question paper. In design, weightage, in terms of marks, time required, objectives (knowledge, comprehension, application, skills) tested, form of questions (essay, short answer, very short answer and objective type), estimated difficulty level of questions (difficult, average, easy) and content area in terms of units and sub-units have been minutely worked out. In the blueprint of the question paper, a two-way matrix based upon the design is prepared in such a way that along rows, units and sub-units of the content area are given and along columns each objective is given which is further divided into four forms of questions (essay, short answer, very short answer, and objective type). Once the format of the blueprint is ready, the cells of the matrix are filled in by a number of questions from different

### Schematic View of Innovative Practices in Students' Evaluation



units/sub-units covering appropriate instructional objectives and forms of the questions. In the detailed marking scheme, a complete solution or solution to each question in a methodological order is given along with the value points for each step of the solution. It is sure that if a question paper is prepared with proper design and blueprint and the answer script is valued in accordance with the detailed marking scheme developed for the purpose, a valid assessment of students' attainment can be done with utmost reliability.

### *Unit Test*

Unit test is another innovation that provides measure for end-of-the-unit or topic assessment of the student. Unit test can be developed well following the steps of a balanced question paper i.e. design, blueprint and detailed marking scheme. In case of unit test, concepts or competencies constitute smaller sub-units of the testing unit (a small delimited area of content is commonly known as a unit). It provides self-evaluation devices both for the teachers and students. Unit tests are much in use and of great help in the internal examination system.

### *Question Bank*

It is a planned library of test items pooled through cooperative efforts for the use of evaluators, teachers and students. The concept of question bank is not very new. Teachers are known to have their private collections of questions that they use for

various educational purposes. What is new about the question bank is that it is now being organised in an institutional framework. In development of a question bank, design and blueprint are very useful. For every content area in the subject, questions representing varied aspects are constructed. These are pooled and every question has an identification code, objective to be measured, difficulty level and the question type. All possible questions covering the whole content area are pooled. These pooled questions give rise to the question bank in the subject. It is very pertinent to also give solutions to each of the questions in the question bank. Evaluators, teachers and students can suitably use items from the question bank for evaluation, instruction and study purposes respectively. Question banks in all the subjects provide an opportunity to formalise evaluation. The UGC has a question bank series in various subjects at undergraduate and post-graduate levels.

### *Model Question Paper*

A model question paper in a subject is developed based upon the maxims of a balanced question paper. In this, proper representation of content coverage, difficulty level, type of questions, assessment of appropriate instructional objectives, etc. are ideally decided along with the ideal solution to the problems. Students as well as teachers can take the model question paper as an ideal

### *Internal Options*

In essay-type tests, students are given choices of questions in a question paper in two ways. Firstly, students are asked to answer a specified number of questions out of a large number of questions given in the paper. Secondly, students are given an option to attempt any one of two or more given questions. This provides students an opportunity to have an option. Both of these cases are known as internal options in the question paper. This is done to give proper coverage of the content and more freedom to students to select questions to answer. This has some adverse repercussions. It leads to selective reading and there is no equivalence possible in the given options. With the induction of objective type questions in question papers, internal options in question papers are not encouraged.

### **Innovations in Types of Evaluation**

Testing, measurement, evaluation, assessment and appraisal are terms used interchangeably in education though they have their own scope and specific meanings. Similarly, evaluation in schools primarily refers to summative evaluation. Other types of evaluation such as formative, diagnostic, self- and peer evaluation are equally important and are being gradually recognised for widening the scope of evaluation as well as instruction. These types of evaluation have been discussed below.

### *Formative Evaluation*

It is the evaluation that is done during the course of instruction with a view to improving pupils' growth rather than merely assessing students' attainment. Formative evaluation helps in keeping tabs on the progress of pupils' growth as well as the relevance of the instructional process. This inter-linkage helps in the visualisation of relevant changes in instructional processes so as to enable pupils to reach their optimum level of growth.

### *Diagnostic Evaluation*

Diagnostic evaluation is done for identification of persistent learning difficulties and reasons thereof in scholastic and other areas of performance and also their origin. Unlike summative evaluation it does not mechanically judge students' growth and development, but identifies why and where the child has learning difficulties and suggests ways to overcome these. Diagnostic evaluation is done with the help of a diagnostic test that has specific steps to raise, a test for diagnostic purposes.

### *Self-evaluation*

Self-evaluation refers to assessing students' performance or progress with respect to self. Even if the child has shown good performance in terms of performance indices, he/she may not be confident enough to display his/her capability in respect of the task. Self-evaluation



assesses these aspects in an individual which is why self-evaluation provides true meaning to the progress made by the child

### *Peer Evaluation*

Peer evaluation refers to the judgement of peers regarding performance/ progress made by the child. Specifically, peer evaluation has tremendous importance in non-cognitive aspects of pupils' growth. It has the potentiality to capture those aspects of progress that the conventional paper-pencil type tests cannot assess properly. With added emphasis on assessment of non-cognitive aspects, peer evaluation and self-evaluation are gaining momentum.

### **Innovations in Techniques of Evaluation**

Techniques of evaluation refer to the procedure employed for evaluation. Internal and external or public examinations, norm-referenced and criterion-referenced and use of multiple testing techniques of evaluation are some of the areas where innovations are in progress besides a totally new technique of evaluation which has its dimensions in information technologies development. It is on-line testing or computer adaptive testing or simply speaking, paperless examination. These have been discussed below in brief.

### *Multiple Testing Evaluation Techniques*

The conventional essay type tests are now gradually becoming outdated. A

number of other techniques are in use these days besides essay type tests. Written examination is not the only testing device. On the other hand, the progress of a child is assessed these days not only in cognitive areas but in non-cognitive areas also, which need a variety of evaluation techniques. In order to assess the presence or absence of a characteristic, more than one technique may be used, which also ascertains intensity or quality of learning attainments. For assessment of scholastic aspects, i.e. achievement, aptitude and special aptitude, written tests of both types, fixed response (objective type) and free response (essay type and context dependent test) may be used.

Conduct of viva voce or oral examinations have added another dimension to evaluation. In subjects like science, the practical examinations provide other techniques. Interview, observation, assessment, group work, laboratory work, tutorials are some other techniques which may be used for evaluation purposes. So far as non-scholastic aspects are concerned, observational, peer appraisal, self-report techniques are used. Assessment of non-cognitive aspects can be done using rating scales, check-lists, questionnaires, interviews, attitude scales, interest inventories, and personality tests following both projective and non-projective techniques. In assessing pupils' in-group sociometry, social distance scale and guess who techniques are

much in use. These multiple techniques used in isolation or in group provide a wider canvas for reliable evaluation of students' performance and progress in all aspects of his/her growth and development.

#### *Internal Examination*

External examinations or examination conducted by school boards of education dominate the present educational scenario. External examination is usually conducted by an institution other than the one involved in the teaching-learning in the school. At terminal stages, state boards of education conduct external examinations in the form of public examination. Public examinations, in spite of many imperfections, are widely in vogue. Internal examination is conducted by persons involved in the teaching-learning process for their own students. Internal examination is conducted by the teacher who is involved with the teaching-learning process. This concept helps in realisation of the ideal interaction of teaching-learning and evaluation. Multiple techniques of evaluation can further strengthen it by the use of a variety of tools.

#### *Criterion-referenced Test*

The present evaluation is norm-referenced evaluation, which shows how a child performs in a group. Though it serves many purposes it lacks in a very crucial aspect—whether the child is able to achieve the set goal (criteria) or not. This leads to criterion-referenced evaluation.

The quality aspects of performance can only be judged by criterion-referenced testing and not by norm-referenced testing. Criterion-referenced testing is gaining ground day-by-day.

#### *Computer Adaptive Testing*

Computer adaptive testing is the implication of the boom in the area of assessment. On-line testing or paperless examinations are other connotations associated with this. With a question bank in a subject and computer software for generating a question paper, any number of papers of comparable parameters can be generated. A child needs no paper, only a computer. He/she can appear for an examination on-line and ascertain his/her attainment in the subject. The day is not far off when any number of students can appear in a paper of their choice at their own convenience and get a report of their performance. This is a promising innovation in educational evaluation.

#### **Innovations in the Framework of Evaluation**

A large number of innovations have taken place in the area of redefining and redesigning the framework of evaluation. Taxonomy of educational objectives leading to instructional objectives and objective based tests, identification of minimum levels of learning leading to competency based tests and mastery learning, continuous and comprehensive evaluation, school based system of evaluation and semester system are a few such

innovations attempting to give a definite structure to educational evaluation. A brief description of these innovations has been given below.

### *Taxonomy of Educational Objectives*

The pioneering work of Bloom and his associates of classifying educational objectives in terms of changes that occur in cognitive (intellectual abilities and skills), affective (pertaining to feelings, attitudes and behavioural tendencies) and psychomotor (manipulative and physical skills) domain have led to the redefining of evaluation in a finer manner. It is this work which has made evaluation apparently observable using hierarchical categories in each domain. These hierarchical categories have further been illustrated in terms of instructional objectives.

### *Instructional Objectives*

Bloom and his associates' classification suggesting cognitive, affective and psychomotor domains of an individual along with their hierarchical categories have helped in identification of instructional objectives in observable behaviours. These instructional objectives have been defined by way of stating general instructional objectives in terms of specific learning outcomes in observable terminal behaviour of students using action verbs, which has simplified the process of relating learning with objectives.

### *Objective Based Test*

Bloom's taxonomy and its hierarchical categories expressed in terms of specific learning outcomes together with concepts in the content area present a two-dimensional picture. Specific type of test item adumbrating the instructional objective presents an item of objective based test. This item ascertains the realisation of the specific objective if the child is able to answer correctly. If the child is not able to answer correctly it means the objective has not been realised. A test containing all items representing the content area for realisation of pre-specified objectives presents the objective based test. Objective based objective type test presents the most reliable tool for assessment of attainments.

### *Minimum Levels of Learning*

Minimum levels of learning (MLL) in mathematics, environmental studies and languages for Classes I to V were laid down by a Committee under the Chairmanship of Prof. R.H. Dave in 1991. These MLLs are expressed in terms of competencies. In the context of MLL, competencies are learning objectives. If a competency has been developed in a student he/she would be able to perform specific tasks related to the competency. The MLL has its concern in the need for raising achievement standards of students in schools. Attainment of MLL means that every student in a specific grade should achieve mastery over all the

competencies specified in a specific subject area and have undergone the stipulated time frame (one year) of learning. Introduction of this concept in education has given new meaning to evaluation also.

### *Competency Based Test*

In the minimum levels of learning at the primary stage in mathematics, environmental studies and languages, learning objectives have been expressed in terms of competencies. These competencies can further be specified in terms of sub-competencies. Acquisition of all sub-competencies leads to attainment of the competency. A test that enables us to ascertain attainment of sub-competencies is known as competency based test. If the child is not able to achieve the standard of attainment in the competency, diagnostic evaluation is required to ascertain the learning difficulties. Once learning difficulties are diagnosed, remedial measures are provided so as to achieve the standard of attainment in that competency.

### *Mastery Test*

Mastery tests are competency-based tests. They determine the extent to which an individual in a group has learnt or mastered a given piece of material or lesson. Mastery in a competency refers to the ability of a student to exhibit learning of all sub-competencies specified in a content area by way of correctly answering questions given in the mas-

tery test. For all practical purposes if 80 per cent students acquire 80 per cent of the competencies, it is said that the competency has been mastered by the students in the class.

### *Continuous and Comprehensive Evaluation*

Introduction of the concept of continuous and comprehensive evaluation (CCE) has given new dimensions to the concept of evaluation. Continuous and comprehensive evaluation postulates measurement of a comprehensive range of objectives concerning intellectual, emotional, physical and socio-personal aspects of pupils' growth in a regular manner coupled with the process of instruction. Thus CCE may be defined as a process of collecting evidence of behavioural changes in scholastic and non-scholastic areas and judging the direction and extent of such changes. CCE also advocates both scholastic and non-scholastic aspects of pupils' growth using multiple evaluation technique together with continuity of evaluation with the process of instruction. This innovation provides ample scope for making evaluation true to its definition.

### *School Based System of Evaluation*

Another important innovation in evaluation that provides a still wider canvas, is the school based system of evaluation. In this approach evaluation is perceived as an interactive phenomenon of many school based variables such as instructional

facilities, school climate, teaching variables, learner variables and all other intervening variables. This provides a solution to the folly of comparing the performance of two students in two different school settings on the basis of marks. The parameters of school-based variables are taken into account while evaluating the performance of a student more specifically, while comparing the performance of two students from two different school settings. Though this concept of school based evaluation is new, it is gaining momentum gradually

#### *Semester System*

The semester system is yet another innovation in education. It visualises the whole educational process in systems approach consisting of inter-linked sub-systems. It begins with the assumption that for the success of the system each sub-system should function optimally. The main purpose of introducing the semester system is to initiate the process of modernisation and improvement both in teaching and learning processes apart from bringing about the much needed reforms and flexibilities in course content and techniques of evaluation. It provides a new approach in which curriculum, instruction and evaluation have a totally new visualisation. In the semester system, the curriculum follows the modular approach or credit course, instructions follow multi-instructional strategies approach i.e. use of lecture, assignment, projects, tutorials, laboratory work, etc

and evaluation follows the credit system in place of marks. With special reference to evaluation, the semester system follows internal, continuous and comprehensive approach of evaluation. Introduction of the semester system at the school stage has yet to start in the country

#### **Innovations in Reporting Evaluation Results**

Another aspect of evaluation in which innovations have been undertaken is reporting of evaluation results (performance). Grading system, portfolio, profile are some of the much debated and upcoming innovations in the area

#### *Grading System*

Grading is essentially a method of communicating measurement of students' achievement. It is a process of classifying students on the basis of predefined standards. Grades are used for conveying students' performance with reference to specified criterion and also the relative position of students in their group. A set of symbols or letters are used to categorise students on the basis of their performance. Grading can be done either directly or indirectly. In indirect grading, the examinee is first assessed in terms of marks which are subsequently transformed into letter grades either using absolute standards or relative standards (Grading on Curve). Overall performance of the students can be expressed by grade point average (GPA) in the

grading system. Three-, five- and nine-point grading are used from lower to higher classes progressively

### *Profile*

A profile portrays a pattern of many dimensions of an individual. Graphical representation, usually a line diagram of the results on several tests or one test helps in easy identification of the areas of strength and weakness of the individual. This way of reporting students' performance in the lower classes as well as their performance in non-cognitive areas is gradually gaining momentum

### *Portfolio*

Portfolio is a personal profile of an individual with regard to all events, activities, likes, dislikes, etc. These portfolios are of great use specifically in analysing a person's behaviour for guidance and counselling purposes

### **Innovations in Management of Examinations**

Perhaps conduct and management of examinations is the area of student evaluation in which the highest number of innovations have been introduced and experimented with. This is so because examinations happen to be the only device for assessing students' performance with wide variations in approach and management. Some of the innovations in the area of management of examinations have been given below

### *Spot Evaluation or Central Evaluation*

In public examinations, a large number of answer scripts are to be evaluated in a specified time period. Sending of these answer scripts to examiners involves a lot of problems. This also leads to various types of malpractices. Spot evaluation is a remedy to this. In case of central evaluation or sport evaluation, expert examiners are asked to evaluate answer scripts at the evaluation centre. In the evaluation centre, they are given a specified number of answer scripts every day which they evaluate at the spot and submit the marks slips along with the answer scripts to the centre coordinator. In each subject, examiners are grouped and a head examiner supervises each group. There are scrutinisers and tabulators also. Answer scripts are given to examiners randomly. Therefore, there are less chances for malpractices. Evaluation work is also done systematically and the results are declared quickly

### *Moderation*

Moderation in examination is done at two levels. First, at the time of development of a question paper and second at the time of evaluation. Moderation of question paper is done by way of analysing the question paper set by a paper setter. A team of subject experts assess the question paper from the standpoint of course coverage, difficulty level of questions, question paper pattern and relevance of answers to questions given in the question paper. Moderation of

marking is done by way of random checking of valued answer scripts by examiners and again by the head examiner so that students are not penalised or rewarded because of the chance factor of whether a strict examiner or a lenient examiner is checking their paper. In an objective type test with detailed marking schemes this threat to a reliable assessment of students' attainment is minimised. Nevertheless, moderation is an innovation in examination that helps in further improvement in the process.

#### *Grace Marks*

Grace marks are provided to below average students who fall in the margin of pass marks in a subject. The arbitrary nature of pass marks is adjusted by way of giving some marks in grace to a student who fails to reach this pass marks marginally. If a student qualifies in all the subjects except in a subject in which he/she has secured slightly less marks than the operational pass marks, he is declared pass by way of raising his marks to pass marks so as to declare him/her passed in the examination. These grace marks help in containing wasteful detention.

#### *Compartment or Supplementary Examination*

If a student has done well in all the subjects except one subject in which he/she has secured such poor marks that even grace marks cannot help him/her to be declared as passed, provision is made for supplementary/compartment examina-

tion other than the public examination in that particular subject. The student has to appear in a supplementary examination conducted after declaration of results in the same session. If he/she qualifies in this examination he/she is declared passed with a remark on his/her progress card that he/she passed in the subject in the supplementary examination. This examination is beneficial to those students who, because of some reason, could not do well in a subject. The eligibility of a candidate to appear in the compartment examination is determined by the examining board which takes into consideration several parameters.

#### *Scrutiny*

This facility is provided by some boards in their public examinations to those students who have doubts regarding the totalling of the marks secured in a subject on payment of a nominal fee. The board makes provision only for retotalling of the marks secured in questions attempted by the students.

#### *Re-evaluation*

This facility has been provided by some boards to those students who have a doubt regarding evaluation of the questions attempted by them. The board charges a fee and students are required to apply for evaluation within a stipulated time from declaration of the results. Another examiner re-evaluates the answer scripts of the students. If there is substantial difference in both the marks (original and re-evaluated) the marks are

changed. If the difference is not substantial, the original marks are retained. Some boards provide for awarding of proportionate increase/decrease in the marks also.

### *Negative Marking*

This practice is mainly associated with objective type test items. It is a way of correction for guessing. If a student answers questions in an objective type test by way of guessing only, there is a possibility that he/she secures some marks. By way of using correction formula, some marks are deducted from his/her total marks. The magnitude of marks deducted from his/her aggregate is known as 'negative marks' and the process of deducting is 'negative marking'. This is done to discourage guessing as well as being a mandatory process to enhance the reliability of examination.

### *Error Analysis*

Error analysis is a process by which common errors committed by students in answering questions are ascertained by way of question-wise analysis of a large number of students who have appeared in the examination. After analysis of answers to the questions in which there are common mistakes, instructional programmes are designed so that others do not commit the same mistakes. This is an effort to improve not only the evaluation but also the instruction. Some boards have come forward in the endeavour.

### *Multiple Sets of Question Papers*

Multiple sets of question papers are considered to be a remedy to mass copying and cheating. Equivalent and parallel forms of the question papers are prepared. Students appearing in an examination are distributed these parallel forms of the question paper (Forms A, B, C, D) in such a way that if they copy they may attempt the questions wrong. Outside mass copying is also checked because there are different question papers in the same subjects at a time being used in place of one set as earlier. The multiple sets of question papers are prepared by way of either placement of questions in different serial order or by replacing the items from the same content area to measure the same instructional objectives or a mix of both of them. Though there are some intricacies involved in it, they can be overcome by further innovations.

### *Transparency in Examination*

Some boards are experimenting with this innovation whereas most of the boards are sceptic about its use as they value confidentiality of examination. In this students are shown their answer scripts after completion of the examination if they so desire. They can see if their answers to the questions are rightly evaluated. If not, they can claim for rechecking, re-evaluation, etc. Usually, xeroxed copies of their corrected/marked answer books are provided to them. Boards charge a fee for it. If there is no change



in the marks they retain the fee and if there is some change in the total they increase the aggregate as well as refund some amount of the fee

### *Open Book Examination*

It is an examination system in which examinees are allowed to consult books and other reference material freely for answering the questions. This practice is mainly related with the problem in conducting large public examinations. It is expected that open book examination will put a check to malpractices and violence during examinations. This practice encourages the study habit, quality learning (avoiding rote memory), eliminates chance element and inculcates self-study habits, etc. Open book examination has some pre-conditions such as setting up of question papers in such a way that only genuine students can attempt questions, setting up of time frame, well equipped library and other reference materials available with institutions and learned examiners to evaluate the answer scripts. A lot more is still required to be done in this innovation.

### **Prospective Areas for Innovations in Educational Evaluation**

Innovations carried out in the past for bringing out reforms in students' evaluation are by no way insignificant. These innovations have brought about certain visible improvements in various aspects of the evaluation system. Evaluation

being such an important and widespread area a lot remains to be done. There are some areas where the spirit of innovation has to be practised and still more areas in which innovations are required for strengthening the system. Question banks, formative and diagnostic evaluation, self and peer evaluation, multiple testing techniques, criterion-referenced testing, school based assessment, semester system, grading, error analysis, transparency in examination and open book examination are some of those areas where focussed attention for innovation is desired. Some of the emerging areas requiring innovations to make the system more effective and vibrant are given below.

- Use of mechanical devices and electronic aids in examination and educational evaluation
- Conduct of achievement surveys at national and state levels
- Computer adaptive testing
- Assessment of non-cognitive aspects of students' attainment
- Establishment of National Testing Organisation
- Introduction of semester system at school level
- Use of grades in place of marks
- Evaluation in distance education
- School based system of evaluation
- Multiple testing technique
- Raising profiles and portfolios

To sum up, it can be said that innovative practices carried out in the past in the area of evaluation have proved their worth in providing solutions to problems that crept up during operationalisation of evaluation in the education system. Though these innovations were sartorial rather than holistic in nature, they have served the purpose of reforming the system. What

is required now is introduction of innovations in the area of evaluation to ensure a method of assessment that provides a valid and reliable measure of student development and a powerful instrument for improving teaching and learning. It will go a long way to make evaluation humanistic, universally acceptable and realistic besides being practical, reliable and valid.

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# Student Evaluation

## Concerns and Perspectives

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### Abstract

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*The main objective of education is to bring out the best in students and to make them self-reliant. Evaluation helps in this by collecting the information, analysing it and making value judgements regarding the quality of outcomes of learning. The students are required to be evaluated not only on the cognitive aspect but also on non-cognitive aspects. In fact the dimensions of evaluation are the identification, selection and preparation of tools, techniques and modes. The teaching-learning activities must synchronise with evaluation. Evaluation should be developed as an inbuilt system in day-to-day education programmes. Its outcomes and prediction must be reliable, valid and utilitarian. It should assess what is purported to be assessed. The present article deals with students' evaluation, concerns and perspectives as well as the whole gamut of the procedure of evaluation.*

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## Conceptualisation of Evaluation

**T**HE classroom teaching-learning phenomenon is a highly systematised process which involves the teachers, students and a set of instructional objectives organised for gaining the end product. Therefore, from the instructional point of view evaluation has been conceptualised as a 'systematic process of determining the extent to which instructional objectives are achieved by the pupils'.

The concept determines two important aspects of evaluation. The first is that 'Evaluation is a systematic process and thus casual and uncontrolled observation is to be avoided' and the second is the 'instructional objectives should be identified beforehand; otherwise, it will be difficult to judge the nature and magnitude of pupils' learning'. Evaluation can be explained as a process of assessing the effectiveness of learning experiences or appraising the extent to which instructional objectives are attained.

The outcomes of evaluation pave the way to revise, classify, modify and improve the teaching-learning materials, the objectives, teachers' skill and strategies of teaching, language of communication and impact of learning on students' behaviour in the total school programme. In a more comprehensive and inclusive term 'evaluation' not only describes pupils' behaviour, it also passes value judgement on teaching-learning programmes quantitatively and qualitatively.

The students possess attributes and traits like intelligence, understanding, comprehension related to the cognitive domains, attitude, aptitude, interest, etc related to the affective domain and skills and activities associated with the psychomotor domain. All these three are required to constitute the complete and integrated personality. The total pupil behaviour operates within three domains. Each trait needs to be measured separately to know the extent of its presence in the pupils.

### *Measurement*

The human mind is guided by quantitative behaviour. Thorndike rightly observed "anything that exists, exists in some quantity; anything that exists in quantity is capable of being measured". According to the *Encyclopaedia of Educational Research*, "measurement means to observe or to determine the magnitude of variations in individuals, actions which are prompted by different local situations and conditions-variables".

Measurement is the first condition of evaluation. Where measurement ends, evaluation begins.

Sometimes, measurement and evaluation are misunderstood as synonymous. But we know that measurement assigns symbols or numbers whereas evaluation appraises the worth or the value. Measurement stops at assignment of numbers whereas 'evaluation goes much further as it attempts to pass value judgement'. Evaluation based on measurement is a "key to bring

effectiveness in the total education process". Measurement is limited to a quantitative description of a single trait or aspect of pupil behaviour whereas evaluation processes pupils' behaviour as a whole and passes value judgement.

In case of the learner, "evaluation is a process of collecting, analysing and interpreting evidence to judge the level of achievement acquired by an individual learner or a group of learners in cognitive and non-cognitive domains for the purpose of making a variety of decisions". Here we are concerned with evaluation of pupil achievement, attainment and performance in the classroom situation. It is an integral and major component of the teaching-learning strategy

### Concerns in Evaluation

The students' examination and evaluation involve various concerns which need to be discussed in the context of the emerging trends of education. A few issues which draw wide attention from educationists and teachers are as follows.

#### *Limitations of Examination*

Examination exists since time immemorial. For over the last half century examination has been discussed widely since the days of the Calcutta University Commission to the NPE (1986) and Programme of Action (1992) recommendations. Every Commission and Committee has pointed out its limitations and shortcomings. It is termed as subjective, lengthy, time-consuming, measuring

only the cognitive field of educational objectives whose reliability and validity are suspect. It does not measure what it purports to measure and seems to be a casual affair being conducted quarterly, half yearly and annually covering mere memorisation and leaving a large number of failures

In the examination, questions are set out of the topic taught from the textbook to know how much an examinee has crammed the information or gained knowledge, it does not measure how much he/she has learnt to apply or use. At the same time marking or method of awarding marks is also defective. An examiner estimates how much marks should be given out of a fixed total. The issues involved here are how to make examination a more acceptable, reliable and valid tool to measure the child's potential to learn

#### *Pass and Fail*

The present system of examination existing since 1857 and introduced by the British, has many pitfalls. The answer scripts are evaluated out of a score earmarked for a set of questions. The results are declared on the basis of the marks obtained by the learner in a particular subject. The cut-off marks for passing is fixed at 33 per cent. It is difficult to differentiate between two pupils who have achieved 33 per cent and 32 per cent respectively. How is one better than the other? If the same script is evaluated by an other examiner 32 per cent may become 33 per cent or even

more and sometimes even less. It is subjective marking. It seems that arbitrary decision is taken without applying valid logic. This way half of the students do not pass the demarcation line. It creates stagnation and wastage of effort, money, time and mistrust in the system.

*Emphasis on Assessing Achievement rather than Quality*

The present day examination is conducted to assess the achievement of the learners in the subject taught in the class throughout the year and declare them to have passed with a certain percentage of marks. It does not explain the quality a student has attained. On the basis of the marks they are ranked, graded and promoted. The student who obtains higher percentage of marks in the concerned science subjects is admitted to medical, engineering and other professional courses. But in some cases this percentage of marks is questioned and thus many professional institutions have now introduced entrance tests for admission in order to know the quality of the students.

The fundamental questions which therefore arise are: Does the present mode of examination judge the quality attainment of the students? Do we assess the abilities related to non-cognitive areas of learning? In fact, the trend is to know the results not the quality. That is why the students passing with good percentage of marks in one class may or may not maintain the same marks or

rank in the next class. This leads to the conclusion that the present examination system is less reliable and valid. One of the objectives of examination should be to raise the quality of education and evaluation.

*Dimensions of Evaluation*

To award marks or grades to the learners by the scheme of evaluation is important but it is more important to cultivate the internal qualities which would help them to become better human beings and enable them to solve the problems of day-to-day life. Education for eternal qualities and their evaluation should be of the greatest concern for educationists today. The following questions reveal various dimensions of evaluation.

- (i) Have we defined the set objectives for a particular level or class to be achieved or attained by the learners?
- (ii) Do we choose the appropriate tools/procedure/techniques to assess the attainment?
- (iii) Why do we give emphasis only to evaluating the performances related to cognitive dimensions and neglect the non-cognitive aspects of growth and development of the child.
- (iv) Do we develop a foolproof mechanism for making regular correction of home and class tasks.

- (v) Do we use suitable and reliable tools to evaluate students' progress and do we practise internal assessment and take it into account while preparing the final results?
- (vi) Do we have a strategy to communicate the results to the students, teachers, parents and the administration?
- (vii) What strategy can be evolved to make examination and evaluation free from fear psychosis and tension?
- (viii) Do we practise diagnostic and remedial teaching in the classes to encourage self learning or self study?

#### *Non-detention Policy at the Primary Stage*

The non-detention policy was advocated so that children at the primary stage were not traumatised and the policy could be used as a tool to promote the children after ensuring a particular level of learning. However, in some states, promotion to the next class has been linked to 60 per cent attendance and the desired level of learning.

The present system of examination and evaluation is lopsided, impersonalised, non-transparent, conventional, imposing and incapable of providing inputs and reinforcement to the proper teaching-learning process and for self-directed study. Thus the system of evaluation is to be revamped and rejuvenated

to make it more effective, reliable and useful. It is necessary, therefore, to discuss the perspectives of evaluation in the fast changing scenario of education.

#### **Perspectives of Evaluation**

The curriculum provides guidelines to organise and impart systematic experiences which lead to emotional, physical and cognitive growth and development of the child. Thus scholastic (cognitive) and non-scholastic (affective and psychomotor) aspects of learning need to be given equal emphasis in school. Simultaneously the evaluation of all these aspects is to be conducted on regular basis so that feedback can be provided and remedial measures organised. These days evaluation is carried out with limited scope, purpose and utility.

The evaluation should be used as a powerful instrument for improving the quality of education in general and the teaching-learning process in particular. The scope, function and purpose of evaluation need to be clearly defined. The evaluation has to synchronise with the changing trend of education and the new perspectives will emerge. Some of them are discussed below.

#### *Minimum Levels of Learning*

One of the innovative methods of teaching is to ensure essential levels of learning, experiences and skills to the child according to the defined instructional objectives of the class or stage. Such a scheme is known as Minimum Levels of



Learning (MLL) which was put to practice as a project during 1991. The instructional objectives and the teaching-learning activities in mathematics, environmental studies and language have been defined as competencies by NCERT up to Class V. These competencies are required to be mastered by each student of the class to the satisfactory level. In the scheme, there is no pass and fail. The teacher repeats the same skills/competencies time and again until every child learns it to masters level. The MLL involves an in-built programme of teaching, learning and evaluation.

The MLL method of teaching is based on child-centred approach, mastery learning strategy, continuous evaluation, diagnosis and remediation, self-learning and conducting action research to provide enough scope for improvement and modification. Now-a-days educationists are stressing the need for competency-based teaching and evaluation from the primary classes itself.

#### *Formative Evaluation*

The need to adopt formative evaluation is gaining ground in developing educational perspectives. The emphasis is to practise it in the classroom situation. The concept is to finish a topic, evaluate, get feedback and reteach. In the scheme, diagnostic and remedial teaching find favour. The benefit of formative evaluation is that the students remain alert all the time as they may be examined any time. It is a type of internal assessment

where marks are taken into account while preparing the final results. Most of the public schools are presently using this method of evaluation.

#### *Continuous and Comprehensive Evaluation*

Generally, evaluation has remained a time-gap affair. It is organised on quarterly, half-yearly and yearly basis. Not only are the examinations conducted only twice or thrice in a year but also, they examine the students' attainment on cognitive level only. The present day education does not favour evaluation of cognitive areas alone but also non-cognitive aspects of growth and that too continuously and regularly. Such a scheme of evaluation is known as Continuous and Comprehensive Evaluation (CCE).

CCE lays appropriate emphasis on the non-cognitive aspect of personality. Human traits like attitude, aptitude, interest, motivation and skills play a very important role in refurbishing and shaping the behavioural pattern of the child. Health and physical education draws our attention as an area that needs to be promoted and evaluated. These factors of education need to be stressed and evaluated. In fact, the emphasis should be on acquisition of competencies in the contents. The students' participation in co-curricular activities, games and sports are required to be encouraged and assessed. The doctor should check up the children at least once a year re-

garding their general health and advise. The evaluation should be continuous, periodical and comprehensive on all aspects—scholastic and non-scholastic.

The purpose of continuous and comprehensive evaluation is to develop a total personality by collecting information, analysing the strengths and weaknesses and providing feedback and inputs. By practising it one can diagnose the deficiency and remediate them and teachers can assess the efficacy of their skills of teaching and communication. On the basis of the results, the teacher can provide differential treatment to different levels of learners such as bright, average and below average.

#### *Grading vis-a-vis Marking*

It seems erroneous to think that a student achieving 33 per cent is better than the student who gets 32 per cent. In the first case the student is declared to have passed whereas in the second he is treated as failed. Simultaneously, a student scoring 45 out of 100 marks is placed in the second division whereas a student obtaining 44 is placed in the third division. Thus way examination is conceived as a luck and guess affair. Now there is a need to make it more rational. The grading system has a wide scope to remove the anomaly of the present marking system. While assessing, the teacher wants to know how his student is doing with reference to himself/herself, with reference to his/her peer group and with reference to the

criteria set in terms of expected level of achievement. The present practice is to assess the attainment on any interval scale that runs from 0-100. Here 0 and 100 do not represent perfect measures of achievement. Though grading has an edge over the marking system, it has yet to take off in our schools.

#### *Educational Testing Service*

According to NPE (1986) an Educational Testing Service (ETS) was to be established to assist the school administration "compare the achievement levels of different institutions and to provide academic inputs to schools for introduction of more innovations". It was also to help the selection of learners for different professional courses/educational institutions and to assist the employing agencies in selecting persons for various jobs. But so far it has not come into existence. There is need to establish such an institution at the national level. Comparison of school results encourages others to make up.

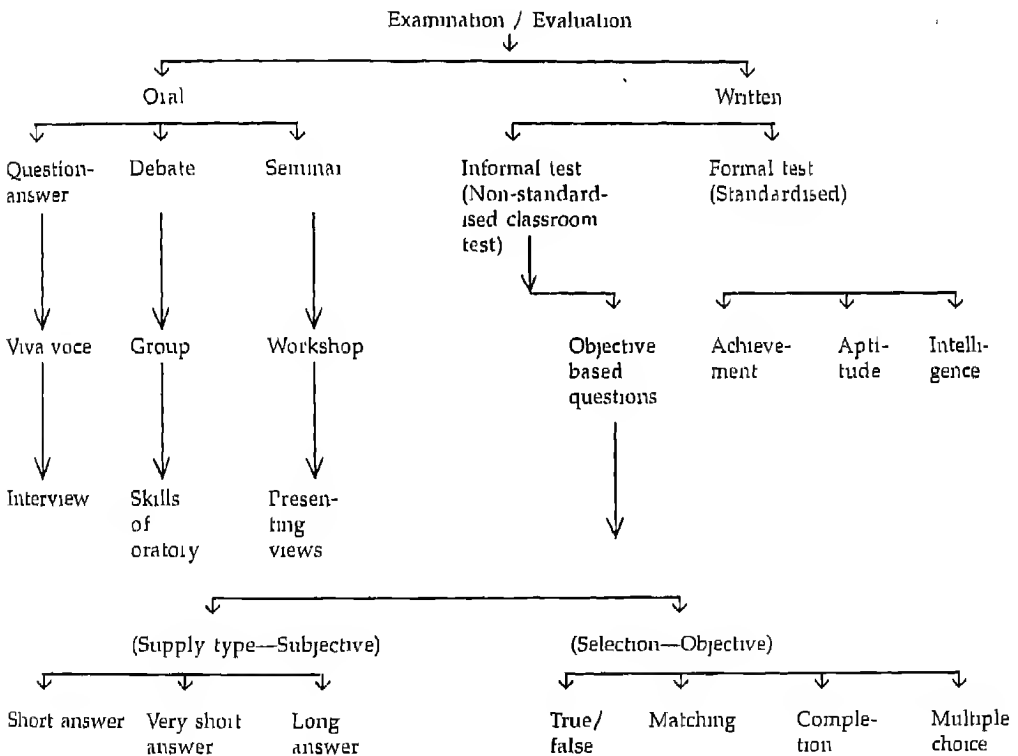
#### *Tools, Techniques and Procedure of Evaluation*

Identification, selection and development of tools, techniques, procedure or mode plays any important role in carrying out the evaluation of students' performance. When instructional objectives—cognitive and non-cognitive—are decided and imparted to the students, it becomes mandatory for the teachers and managers of education to think

about how to evaluate the level or amount of achievement in the subject concerned. Wrong selection of tools, techniques and mode would certainly lead to wrong results. For evaluating scholastic performances of the students, the following tools may be useful.

involve any fear, tension or unlimited labour. However, the open-book mode of evaluation is limited to projects and assignments. It is not allowed in public examinations.

The teachers should be trained in developing and selecting appropriate tools, techniques and modes of evalua-



Apart from the above, projects and assignments are also used now-a-days. This type of evaluation provides enough scope to the pupils to think, organise the contents and put them down in a proper answer form. This is known as open-book mode of evaluation which does not

involve any fear, tension or unlimited labour. However, the open-book mode of evaluation is limited to projects and assignments. It is not allowed in public examinations. The teachers should be trained in developing and selecting appropriate tools, techniques and modes of evaluation, making suitable judgement and deriving feedback from all sources. They should assess the amount of actual academic and non-academic work the learners are doing and the abilities they are attaining. At the same time, the teachers should understand the

situation which would help them to develop the objective type test for evaluation of various abilities and attributes of the learners

Evaluation should take composite charge of the teaching-learning process and learning outcomes right from the primary to the school stage and even beyond that. New trends are emerging in the society and the evaluation system has to meet and match them. The schools and teachers should adopt the right attitude, suitable tools, techniques and procedures of evaluation to get feedback for improving the entire process of

learning. As the concerns and perspectives of education are changing, the perspectives of evaluation also have to change accordingly. The entire teaching-learning spectrum, especially at the school stage, needs to be reformulated and redefined. The evaluation perspectives exclusively and inclusively are required to be revamped and restructured. It has to be carried out hand-in-hand with the educational activities practised inside the classes and outside. Students' evaluation should be developed as an in-built system of the teaching-learning process.

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# Autonomy and Accountability in Students' Evaluation

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## Abstract

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*The present paper discusses autonomy and accountability in the context of students' evaluation. It considers that compatibility between the two may lead to improved learning. It talks about the paradigm shifts as a consequence of contextualisation of school education. Besides highlighting the partial autonomy that prevails in respect of students' assessment, it reflects on the Central Board of Secondary Education's experience of grant of autonomy. The paper contemplates issues attached to autonomy and accountability. Finally, it argues that the two can go hand-in-hand provided there is a proper climate, competence, confidence and commitment.*

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**H**UMAN empowerment is a graded phenomenon. It starts right from the time a child is born and continues instinctively until the end. This process has undergone a sea change in the recent past as a consequence of both information technology and globalisation. This has eventually led to the rise in the expectations of the people in every sphere of life. The field of education is no exception. But the paradox is that while the 'knowledge workers' crave for autonomy, the people at large clamour for accountability. Compatibility between the two in the context of school education in general and students' evaluation in particular may lead to improved learning.

### **Evaluation in School**

The whole field of differential psychology is based on the fact that individuals differ and that these differences are important to us and that we need to know these differences for the purpose of making a variety of decisions. It is for this reason that we resort to testing. The field of testing is both exciting and controversial. The anomaly is that people desire excellence, yet oppose testing that makes excellence possible. Ebel and Frisbie (1986) have rightly observed that if we want more efficient and productive schools, if we want to motivate and reward efforts to learn, if we want to deal fairly with individuals on the basis of their capabilities, we need more examinations and not less. Similarly, Stiggins (1994) observed that if you wish

to appear accountable, test your schools, if you wish to improve the school, teach teachers to assess their students and if you wish to maximise learning, teach students to assess themselves. So much so that evaluation is considered the most difficult part of the teaching profession. It requires more thought and energy than anything else, for a teacher has really to make sure that he/she is doing it to the best of his/her ability and that his/her students are deserving of the evaluation they are awarded. Indeed, it does explain the sensitivity that is involved in evaluating human potential.

It is true that teaching for successful learning cannot occur without high quality evaluation. Teaching, therefore, needs to be completely integrated with evaluation. This integration needs to be carried out on hour-to-hour and minute-to-minute basis. High quality evaluation necessarily should yield valid information on three counts pertaining to both cognitive and non-cognitive learning outcomes. One, how the child is progressing with reference to himself/herself. Two, how the child is progressing with reference to his/her peer group. Three, how the child is progressing with reference to the criteria set by the teacher. The current practices are likely to have difficulties meeting these standards.

### **Current State**

Evaluation has undergone a sea change with the changing times. Nevertheless,

the changes that have occurred the world over have failed to evolve a single most effective method of evaluating students' performance. The international scenario is replete with instances of different colours and shades of students' assessment. Not only does it vary from nation to nation but it also varies within a nation. The method by which students' evaluation is practised in our schools leaves much to be desired. In its present form it does not capture the real potential of students. There are a lot of pitfalls. Evaluation in its present form is neither fulfilling the aim of improving learners' quality nor that of universalising the improved quality.

If we look back a decade or so, we find that we have not been able to make much breakthrough in the area of students' evaluation. We still cannot resolve the very issues that we had before us at the time of the formulation of the National Policy on Education, 1986. And, now in the light of the emerging needs of contextualisation of school education, there seems to be a paradigm shift which requires a fresh look. As of now, the primary outcomes are no longer confined to recall of facts, they are viewed as ability to transfer ideas. Curriculum framework is transformed into an integrated curriculum instead of isolated topics. Instructional material is no longer a single textbook, it includes a number of print and non-print materials. The role of the teacher is transformed into that of a coach rather than of an information giver. In the light of this paradigm

shift, the key question is how to go about it. And, linked with this are a myriad of questions including that of autonomy and accountability.

### **Autonomy**

The word 'autonomy' signifies control over one's affairs. Today, when we are debating the issue of autonomy in the present context, some of our fellow members in the tertiary sector are up in arms against autonomy. Interestingly, the issue of autonomy in students' evaluation is associated with a variety of questions. What degree of autonomy do we want? And, linked with this is the issue of the four C's. One, do we have the proper climate to go in for autonomy? Two, do we have the competence to shoulder this responsibility in a meaningful manner? Three, do we have the confidence to plunge into it? Four, do we have enough commitment to accept such a responsibility? If we have all these four C's, then I again come back to the issue of autonomy. And, now I will refer to the autonomy that already exists in our systems.

We have practical examination in science at the end of ten years of general education. The Central Board of Secondary Education (CBSE) has given absolute autonomy to individual institutions to evaluate its students and award marks. And, the general experience says that almost every student is awarded marks somewhere between 23 to 25 out of 25. Let us go a step further. In the Class XII examination, we have a

system wherein students' performance in practical examinations is assessed by an external examiner. Even then there is so much of manipulation that most of the students manage marks between 25 to 30 out of 30 regardless of the acquisition of necessary practical skills. Why is it happening this way? The answer to this is that there is a lack of the element of accountability.

In the present circumstances, my fear is that autonomy without accountability will lead to anarchy and a chaotic situation. The word 'accountability' here means to be responsible for one's own actions and in this case to the authority. Here, I may like to add that accountability is a mental attitude. In our day-to-day life we come across some people who prefer to say "no" to an assignment, if it is beyond them, rather than doing a shoddy job.

### **Autonomy : an Experience**

It may be in the fitness of things to refer to the CBSE's experience of grant of autonomy. In the year 1991, the CBSE floated the idea of grant of autonomy to schools. Not many schools came forward. Eventually, autonomy was granted only to two schools, namely, National English School, Bangalore, and Vidya Niketan, Pili. These institutions were given the authority for recommendation of issue of certificate. And, what was this autonomy? The autonomy of evaluation was granted only for the secondary stage and that too only in two subjects viz. science and mathematics.

Under the autonomy these institutions were asked to submit the scheme of evaluation to the Board, not to alter the syllabi approved by the Board, adhere to all the norms prescribed by the Board with regard to textual materials, qualified teachers and teaching hours, etc., to organise orientation programme for its teachers, constitute a monitoring committee with the concurrence of the Board and to agree to periodic inspection by the Board. To top it all, the Board reserved the right to withdraw autonomy in case of falling academic standards or violation of any of the terms. Somehow, this did not turn out to be a happy experience.

### **Models of Autonomy**

We may have a number of models like absolute autonomy with absolute accountability, partial autonomy with absolute accountability, partial autonomy with partial accountability and so on. I am for absolute autonomy with absolute accountability. Here I would like to add that demand for accountability may demand demonstration of the merit of the school and the extent to which it fulfills its goals and meets the needs of its clients. I am of the opinion that absolute autonomy would increase the commitment of the staff and institutions but together with this, strong accountability is also needed.

Institutions may be given complete autonomy in respect of evaluating students' performance that may include a whole range of activities right from designing



the testing calendar to awarding the certificates. This would obviously warrant organisation of faculty improvement programme with a view to building capacity to the extent that they not only appreciate the significance of self-referenced, norm-referenced and criterion-referenced measurement but can also generate and handle the tools required for all these outcomes.

### **Accountability**

Accountability is perceived differently by different people. For some, accountability includes setting right goals, assessing their degree of realisation and accepting responsibility for any results that are perceived inadequate. For others it may also require an explanation for the lapses on the part of those responsible for the implementation of the programme.

It may be pertinent to mention here that the issue of accountability is very topical in several developed nations. In the United States, the Governor of Texas who is a candidate for the Presidential election talks glowingly about the improvement in Texas education. The state proposes to pay five thousand dollars to those schools which would display excellent performance. Basically the schools would be rewarded on the basis of their performance. The aim is to ensure that the children start learning and that they receive quality education.

On the accountability aspect, institutions will have to measure upto the expectations of their clients, the state

and the nation. For this, it will be appropriate to have a National Accreditation Society which when approached may undertake the evaluation of the institution. It implies that such an arrangement may be on voluntary basis. Institutions may obtain accreditation certificate, if they so like, on yearly basis or on periodic basis. It may be pertinent to mention here that institutional evaluation need not confine only to students' evaluation. It may also encompass other indicators of school quality such as community and students served by the school, school vision, school personnel, material resources, educational programmes, school achievements, etc.

All this would require a fairly high level of sophistication on the part of teachers. If they are to be central to the success of the new evaluation system, there will have to be a considerable amount of inservice teacher training. Besides, this would also require a considerable body of objective instruments that could provide information about individual differences. This, in turn, would warrant test developers to base their tests in the light of the findings of psychological researches. Classrooms will need to have storage facilities to accommodate student portfolios.

Such a proposition of institutionalising autonomy in students' evaluation is not something that cannot be achieved. It can be achieved provided we build for it the proper climate, competence, confidence and are genuinely committed.

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# Language Testing

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## Abstract

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*The present paper begins with the need for tests and the various classification of language tests. The analysis establishes the role of language testing. It then dwells on the usefulness of tests for students and teachers. Briefly, it then recalls the changes which have taken place in language testing. Addressing the language teacher certain suggestions for designing a language test are made, followed by some examples. Teachers are encouraged to prepare test items and the whole test carefully with a proper scoring key. Precise instructions in simple language are to be given to the students. The paper ends by making tests student friendly. A conclusion can also be drawn that the quality of test material should generally be related to the conception of the whole of language teaching and learning. Testing should be such that the fear psychosis of the students should end so that tests can have direct and positive impact on teaching and learning. Students will show enthusiasm and an ability to select their own tests and thus cooperate in their learning.*

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**T**HERE is a general feeling that testing is an esoteric process. It deals with difficult things, different and difficult items. Testing is concerned with statistics and figures, about which many of the teachers seem ignorant. However, a look around shows that testing is directly related to our day-to-day life. Consider your visit to the doctor. The patient has to be tested to find out what is wrong with him/her. Similarly, it is a test for the doctor. The doctor examines with the instruments at hand and after testing and thinking gives a certain verdict. If the examination is not complete he/she advises blood test, etc., and that also of various specifications of which we are aware. The blood tests for different diseases will be different. From the results of these tests the doctor prescribes the medicine. You take the medicine. After some time you feel better and tell the doctor so. If you feel worse, you again consult the doctor.

Or how does one go about buying a new refrigerator. You talk to your friends, you look at it, touch it, feel it. You then ask the dealer about it, ask for a demonstration. The next time you again see it, feel it, touch it and then buy it. You get it installed at home and check it.

Now, let us look at the language part involved. All the language skills are called into play. A certain amount of body language, facial expressions, gestures are also involved. Listening, Speaking, Reading and Writing play impor-

tant roles and any slight mistake may lead to disturbing results. Testing should not be thought of only as the technical area of language teaching (Skehan, 1988). Tests are related to the 'real' world, which is non-linguistic and yet full of tests, examinations and challenges which we face and solve. Testing therefore has its obligation to the society since it draws heavily on it.

### Testing

Testing is a very important part of every teaching and learning experience. According to Alderson (1987), every language teaching situation involves a test. Tests are to be used at the beginning to determine readiness, during the course to find out student progress, and at the end to find out the effectiveness of teaching. "The relationship between teaching and testing is that of partnership," says Hughes (1989) "and it should have a corrective influence on bad teaching." Testing is a way through which we will know whether learning has taken place and whether the teaching has been effective.

### Conventional Categories of Tests

Following are some of the most common categories of language tests, after Hughes and McGrath.

#### *Achievement/Attainment Test*

A backward looking test that measures the extent to which a student has learned what he was intended to: normally

based on syllabus, standardised and large-scale. A good achievement test contains material that was actually taught. Achievement tests are normally prepared by the staff of the instructional programme in which they are used. Achievement tests should give an idea of the outcomes of learning.

#### *Progress Test*

It is an informal achievement test based on a section of the syllabus course context.

#### *Proficiency Test*

A forward-looking test in that it measures a student's readiness to undertake a particular course of training. It measures the student's overall ability in language along a broad scale. Proficiency is usually defined independently of any instructional programme.

#### *Placement Test*

A test used when the results determine the level of instruction for which a student is ready.

#### *Aptitude Test*

It predicts future performance.

#### *Diagnostic Test*

It measures specific aspects of language ability, usually for the purpose of determining what the student knows and needs to learn. It points out the strengths and weaknesses of the students.

### **Uses of Tests for Students**

Students are frequently evaluated in any educational programme. The results from a test provide information for making decisions, and these are regarding students. So broadly speaking, we can say tests are used, according to Bachman (1990)

- (i) As sources of information for making decisions within the context of educational programmes, and
- (ii) As indicators of abilities or attributes that are of interest in research on language, language acquisition and language teaching.

Testing helps students in many ways.

1. It helps create a positive attitude towards the class. Tests give students a sense of accomplishment, that is provided through periodic evaluation which also ends dissatisfaction. Tests of reasonable difficulty level announced in advance and covering skills scheduled to be evaluated, can contribute to a positive tone in the class.
2. Language tests benefit students by helping them master the language. They will study hard for the examination, and may profit from a discussion of their evaluated answer scripts. Students also learn by their growing awareness of the objectives and the areas of emphasis in the course. Tests can foster and encourage

learning by their diagnostic characteristics and will make the students aware of their personal language.

- 3 The purpose of each language test is different. Language tests are instruments or procedures for gathering particular kinds of information having to do with students' language abilities
4. Tests also create positive attitudes towards instruction in the overall teaching-learning process

However, tests may also be damaging, and produce 'negative motivation' by forcing students into unwilling activity to read and study

### Uses of Tests for Teachers

Tests are useful to diagnose the teacher's efforts as well as those of the students

- 1 They help the teacher to question the efficacy of the method of teaching, or the level of the course or its objectives. They point out which areas and skills need special attention.
2. Tests provide insights into ways that can improve the valuation process itself. The teacher can benefit from thinking about whether the instructions were clear. Was the given time sufficient? Did the students show any anxiety? Therefore tests can improve
  - (i) Teaching, and
  - (ii) Evaluation

Tests should enable the teacher to assess his/her own deficiencies and to develop strategies for better classroom transaction.

This instructional aspect of testing is very useful. It tells us the relationship between the course and the test, the relationship between teaching and testing. In other words, a test can tell the teacher

- (i) How testing can influence teaching
- (ii) What changes in teaching/teaching styles may be made, and
- (iii) What insights can be gained about language learning

Feedback from the test is useful for the teachers and the students. Necessarily done at continuous intervals, tests help the teacher in formative evaluation which helps and guides both teacher and student to change their methods of teaching and learning at the proper time. Summative evaluation, on the other hand, is the student's progress in the form of marks or grades at the end of the course.

Tests, therefore, confirm progress, redirect our future efforts and thus help learning and sustain class morale. Testing is integrated with teaching : it is to be done more often, though not obtrusively, it should become inseparable from learning.

### Language Testing

Of late there has been a shift of emphasis in the teaching of languages. Whereas in the past the emphasis was on the

structural features, now because of the communicative teaching methodology, the focus is on the social and psychological dimensions of language use. This has had its effect on language testing.

Tests based on the structural approach are what Carroll (1961) has called discrete-point tests. According to Spolsky (1985) their weakness is that the theory does not give any reason justifying the selection of a specific item. The functional approach is based on the assumption that the nature of language knowledge is captured by detailing the various uses to which it can be put. It aims to list all possible functions of language including the notions that can be expressed in it. The functional approach has led to communicative tests.

A language test is an indicator of a given ability. Modern tests are not developed and used in isolation. They are always intended to serve the needs of an educational system and of society at large. As Cronbach (1984) says, "testing of abilities has always been intended as an impartial way to perform a political function—that of determining who gets what."

Language testing is testing the skills and the sub-skills of language. In addition, we emphasise evaluation of language use rather than language form only. The primary purpose of language tests is to evaluate real communication. Therefore communicative tests measure more than just isolated skills. We would like to find out how well a person can function in a language. While tests of

language sub-skills measure the separate components such as vocabulary, grammar or pronunciation, etc. the Communication Skills tests show how well the student can use the language in actually exchanging ideas and information.

### Teachers and Testing

Tests help us to take decisions about teachers in an educational programme. Selection of teachers can be made on the basis of information provided by them. We can know about their language abilities through a proficiency test. This test will be very different and more demanding than that used for the learners since a teacher has to be proficient in the complete range of language abilities, besides being competent in pedagogy and socio-linguistic knowledge so that learners can talk to him/her in an instructionally useful manner.

Future programmes benefit from the information language tests provide. When a new programme is to be developed we would like to evaluate it in terms of appropriateness, efficiency and effectiveness. A test can be used for these results so that these qualities can be maximised. Achievement tests can provide information as to the extent to which the objectives of the programme have been realised. The deficiency so highlighted can be taken care of in a follow-up programme.

Reluctance of teachers to administer tests is also because they think preparation of tests is time consuming which it is, since a good test takes much time

to prepare. Some teachers feel that tests go against the humanistic approach to teaching. Above all, many teachers claim they have no expertise in designing tests.

Language teachers have to be abreast of new developments about language and language learning. As Skehan says "a large part of language testing has to be concerned with the evaluation of change and progress, very often against the background of the teaching that students are receiving."

Teachers should be convinced about the efficacy of the new pedagogy and pupil evaluation procedures and treat evaluation as an integral part of the teaching-learning process. This should help in the understanding of how much the educational process can build on what the student already knows.

### Designing Language Tests

When planning and preparing tests teachers have to select what they consider most important in the content and/or the language aspect, not what will be easiest to test.

As language teachers we have to see that the test format covers

- demand for context
- information gap activities
- authentic language, real life situations
- participant roles, emphasis on discourse
- integration of skills, integration of language skills

Language tests should cover areas of language, grammar, vocabulary, phonology and skills, both content and tasks. The aim is to test not only how much language a student knows but also his/her ability to operate in a given sociolinguistic situation with specified ease and effect.

The language test has to be made as attractive as the teacher's own teaching. Instead of always resorting to the textbook and the conventional format, some material can be obtained from different sources such as the newspapers, advertisements, leaflets and stories that fit the given content of the course. This material can be both written and spoken. Activities in a test may then be selected that best measure performance such as role play, pair work, recitation and individualisation.

While framing a language test we have to avoid items that are ambiguous, tricky or overlapping. Above all, teachers should make sure that they themselves will be able to answer the questions they have set for their students within the given time, within the given word limit, etc.

Instructions to the students have to be clear and simple. They have to be student friendly, comprehensive, explicit, and accessible. Insist that the students read and understand them properly before attempting the test.

While designing the test layout try to make the test visually attractive. Variety can be introduced through pictures,



different type-faces and any element that can reduce anxiety of the students.

The teacher has to consider the scoring system very precisely. It would be better to consider testing as team work rather than a solitary activity. The teacher who has made the test can get it checked by another teacher, both in terms of the items and the scoring. Finally the test has to be evaluated with the help of the students. The teacher can ask himself/herself questions such as

- What did the students think about the fairness of the test?
- What results are due to poor test construction? How could the items be improved?
- What results are due to poor or insufficient teaching?
- What results are due to course book or other materials?
- What areas of weakness in student performance have we detected for remedial work?
- Can we make any assumptions on the relation among teaching, learning and testing?
- What changes should be implemented in the classroom as a result of the feedback?

Teachers should listen to what the students have to say through feedback and performance and profit from their comments, by a change in their teaching if necessary.

## Some Examples of Test Items

### *Pronunciation*

Verbal ability, a predominant characteristic of an achiever in life is a powerful tool that needs to be wielded with great care. In view of the benefits that one enjoys with improved oral fluency, it should be attained by investing sufficient time and effort.

Visuals can be given by the teacher to pairs of students who will in turn talk about them. Students will correct each other and then they will be corrected by the teacher, if necessary.

The teacher can choose, say, four different pronunciation problems of students and prepare a sentence illustrating each. Students listen and repeat.

Recent studies have investigated the nature of interaction in oral proficiency examinations. It is found that the interview format obscures differences in conversational competence in the language learners. Conversational interaction is more focused in guided role-play than in simple intervention. Guided role-play activities reflect several characteristics of real life conversation and can be useful for assessing a student's conversational competence.

The design of listening materials has yet to incorporate features of real use. However, we have at least learnt the value of exposing students to such authentic material with great variations. Listening will involve a great variety of activities with a focused exposure to the language.

### Grammar

Each of the following items has some defect. Indicate what the defect is and then correct it by rewriting the item.

"Sita nearly won that race." "Yes . . ."

- (i) She ran well, did she?
- (ii) She ran well, wasn't she?
- (iii) She ran well, was she?
- (iv) She ran well, didn't she?

Write down as many words as you can that appropriately complete the sentence given below .

He walked. . . . the house

### Reading

Three related sketches may be given to different groups of students. The students will read from their sketches and necessary change will be incorporated by all of them, resulting from a discussion, after comparing the sketches

Students may be given passages for comprehension. These may be different from those given in the textbook. Passages for comprehension may be

- (i) Unseen prose passage
- (ii) A short poem
- (iii) Advertisement from a newspaper
- (iv) Newspaper article

The teacher may prepare a list of signs usually observed all around us. Students will read aloud these signs. These may be

Danger	Doctor	School	Hospital
Speed Breaker	Blow No Horn		

### Writing

Copying is the simplest test that can be given to students. This will also be checked by the students themselves

The teacher can give some unpunctuated sentences to the students who will punctuate them correctly, adding capital letters where necessary and checking spelling as well. Creative writing can be of great benefit to the students and they can be encouraged to compose short poems and short prose pieces on a topic of their own interest.

### Vocabulary

Tests can be developed on content lexical items. These may prove to be helpful in increasing students' vocabulary and in helping them understand better the words used. The test enables the student to learn words in context and/or in relation to one another as synonyms and antonyms. A better understanding of the words will allow students to improve and enhance their writing skills.

### Synonyms

Ambition—aspiration, longing—zeal,  
Humble—poor, plain—simple,  
meek—modest

### Blemish

a Disgrace	b Eccentric
c. Boring	d. Flaw

### Antonyms

Barren—fruitful, rich, fertile, prolific  
Difficult—easy, obliging

Filthy

a. Foul

b Rhetorical

c Clean

d Reflect

Classify the following words as synonyms and antonyms

Different, straight-forward, obvious, puzzling, perplexing, clean, confusing, bewildered, simple, hard, easy, lucid, enigmatic

Find the related words for the word 'Programme' in any teaching-learning programme

Unscramble the following jumbled words to find commonly used words.

a HKIE

b ERTORR

c UQEUE

d. NGIR

*Use of Phrases*

Bone—I have a bone to pick with you.  
(*I have something to complain about to you*)

Ear—My ears are burning  
(*Other people are talking about me, it seems*)

I am all ears.  
(*I am keen to hear everything.*)

Eye—Keep an eye on it.  
(*Take care of something.*)

Hand—A big hand for our best pianist in town.  
(*Let us welcome this person by clapping*)

All hands on deck.  
(*Everyone must report to work.*)

Tongue—It's on the tip of my tongue.  
(*I cannot quite remember although I am thinking hard.*)

Language teachers thus need to be creative and innovative. Activities like these make vocabulary learning enjoyable and enable students to develop sensitivity towards the language

### Tests and Results

The results of a test are not always used for the purpose for which the test was given. As Baker (1989) says, "Not all language tests are tests in the real sense of the word." For example, the final test, generally at the end of the year, should decide who should go to the next higher class. But whatever be the performance of the students in the test, all the students pass. Therefore the achievement test remains only a ritual because the result does not change anything.

Similarly, a progress test should guide a teacher's decision about his/her teaching. In most cases the main purpose of such a test is to act as a goad to encourage students to work harder.

Many times, as Baker comments, there is a trade off between ease of administration of a test and the confidence which is placed in its results. Therefore a placement test which consists of an oral interview, and some writing tasks will not be preferred to a twenty-item multiple choice test, since it involves a lot more time and trouble.

Concern has been expressed about examinations and the fear psychosis

that grips children at the mention of testing and evaluation. The examination system causes stress and strain. There is also a proposal to have walk-in examinations. Testing today has to help in removing this fear psychosis. Testing and evaluation do not have to be the unpleasant experience that they are today.

The idea of teachers preparing their own tests seems impractical to them—it takes too much time. As, perhaps, this paper has shown, language testing need not be all that exhausting. If the teachers work in groups and discuss language points with language teachers and other teachers as well, a wealth of ideas can

be produced in the groups. This will give a much needed boost to teachers' confidence. More emphasis should be given to the preparation of students for individual work by getting them acquainted with techniques for self instruction and self evaluation.

Further, we have to think seriously whether students have to be evaluated informally on a day-to-day basis or whether a formal evaluation will be essential at all levels. These objectives can be achieved by demystifying report cards and emphasising the need for open-ended and flexible approach in line with the stage of pedagogical renewal.

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# Assessing Non-cognitive Learning Outcomes

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## Abstract

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*In the present paper an attempt has been made to deliberate on the issue of non-cognitive learning in schools. The importance of non-cognitive learning is beyond any dispute, yet it is marginalised in practice to the extent of neglect in the whole educational process. Non-cognitive learning has its own characteristics. Owing to its special features the assessment of non-cognitive learning becomes quite different from that of cognitive learning and encounters a number of problems. These problems are due to copious reasons, which are related to the nature of non-cognitive learning. The reasons include inadequacy of tools, faking, difficulty in capturing evidences, low reliability of the result and deficient reporting. The present paper also discusses the steps involved in the assessment of non-cognitive learning at the primary stage. It is supported by a brief outline of a programme of assessment at different levels of the primary stage to give an idea for its operationalisation.*

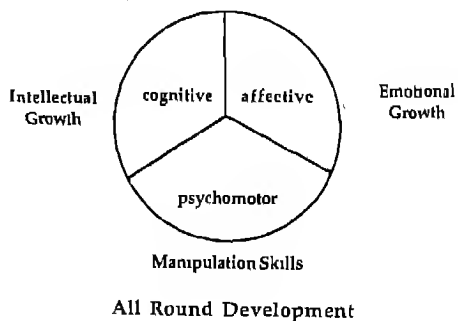
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## Relevance

**T**HE primary function of education has been considered the all-round development of individuals for ages. The hallmark of this development is reflected when the different aspects of personality are developed, measured and assessed effectively. In view of this the schools have a major responsibility of developing all desirable cognitive and non-cognitive characteristics in the students enabling them to live effectively in a society which is rather complex in nature. This can materialise only when strong instruction and assessment are enforced firmly in the educational process. Unfortunately, the educational system of the world failed to see the totality of the development by giving extra edge to simply intellectual and academic development and completely ignoring the affective and emotional development of the students. The absence of non-cognitive growth in students is a fall-out of the legacy of the educational system of the preceding century. This paved a way for structuring a violent, and incohesive society full of tensions and crises.

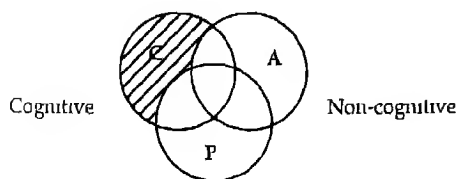
Do we still want to continue with the same system in the new century and remain in the same kind of society? If not, it is quite important to restructure our educational process wherein the non-scholastic areas should be injected firmly to produce tolerant, emphatic and considerate citizens who, in turn, make a democratic, non-violent, cohesive and peaceful society. Now the trend is deviating from the earlier path and more

stress is being laid on emotional intelligence than only on academic excellence. It is believed that emotional intelligence contributes 80 per cent towards success in life. Endorsing this opinion Daniel Goleman (1995) prescribed the qualities which make emotional intelligence. These are self-awareness, mood management, self-motivation, impulse control and people skill. In other words, the personality traits, which need to be developed and assessed. It is important to keep in mind that it is the properties of people which are evaluated, not the people themselves. Generally, three main domains, namely, cognitive, affective and psychomotor are considered to be the components of total personality. Cognitive symbolises intellectual skills and knowledge, affective encompasses characteristics such as social-personal qualities, interests, attitudes and values. The psychomotor domain deals with the manipulative skills generally used for vocational success. The following pie-chart shows the different dimensions of personality growth wherefrom a number of personality traits can be delineated.



### Concept of Non-Cognitive Learning.

As indicated in the above chart the emotional growth appears to be an equally important component of personality as the other components. Personality has been defined by scholars as a set of cognitive and non-cognitive traits (Ebel and Frisbie, 1979). This set includes elements of intellect, achievement, values, attitudes, appearance and so on. These are also classified as scholastic (cognitive) and non-scholastic (non-cognitive) areas. Scholastic stands for intellectual development and non-scholastic for other affective and psychomotor areas. Interestingly, there is a slight overlapping on the affective dimension from cognitive and psychomotor areas. It is because no learning can take place in the absence of cognition. Therefore the non-cognitive area does keep ostensibly a certain amount of cognition in it, whereas the whole of affective and psychomotor domains constitute non-cognitive area excluding that part of affective and psychomotor domains in which dominance of cognitive skills is imminent. In the following Venn-diagram an effort has been made to show a rough distinction between cognitive and non-cognitive aspects representing them in shaded and unshaded regions.



There is another classification with regard to testing total personality. One test measures maximum performance and the other seeks to determine typical performance. Tests of habit, interest and character fall in the second category (Cronbach, 1960). These are also termed as typical behaviour. It may be concluded that typical behaviours constitute non-cognitive learning. However, the present paper advocates inclusion of physical growth, social-personal qualities, interest, attitudes, and values under non-cognitive areas. Though physical growth may not be considered as a part of the affective area, it is included as a part of personality appearance. The areas which can be developed and assessed in the school situation will constitute the scope of non-cognitive learning for the purposes of assessment in school.

By and large, schools lay emphasis on the cognitive domain in the educational process for the child and believe that affective areas do not contribute much towards academic success. This situation continues in spite of the fact that educators are consistently harping on the point that total personality growth cannot occur in the absence of non-cognitive growth. Time and again, various commissions and committees have stressed on the responsibility of the schools to develop the non-cognitive characteristics of students along with scholastic potentials. The National Policy on Education, 1986 also underlined forcefully the assessment of

non-scholastic areas under the continuous and comprehensive scheme. The learning of non-scholastic areas is not only helpful for living a quality life but has direct relevance to the ability to learn, interest in learning and values education. Sometimes, learning difficulties creep up due to personality problems in some students (Rutkowski and Domino, 1975; Calsyn and Kenny, 1977). These problems can be solved after getting feedback of their strengths and weaknesses in scholastic and non-scholastic areas. This feedback helps the knowledge workers to understand the students better and help them improve their learning speed and remove impediments to learning if any. In spite of these advantages of assessing non-cognitive characteristics, the fact remains that this is a very weak link in the field of educational evaluation.

### **Problems of Assessment of Non-cognitive Learning**

The role of assessment is to provide accurate and relevant information regarding the differences of individuals with regard to their progress in the areas of learning. Educators are concerned with the measuring of progress of students. As far as the evolution of non-cognitive learning is concerned it is quite problematic because sound decision making is not an easy task in this realm. There are innumerable problems with regard to assessment of non-scholastic areas. The first and foremost is the definition of non-cognitive areas in the curriculum.

This creates ambiguity and slackness on the part of teachers to carry out the developmental activities and proper assessment. Secondly, the teachers do not get adequate training in their pre-service training programmes which are generally loaded with teaching strategies of scholastic areas. Even the in-service programmes lack this input completely due to a fixed mind-set of tilting the balance towards the growth of scholastic areas. Besides these curricular and training deficiencies there are some practical problems related to assessment of these areas directly. These are response set, faking, low validity, reliability, interpretation and bias. Another interesting aspect of the problem is differences among individuals and changes in their behaviour over time. There are certain traits which take long to develop and their assessment at a point of time may evince a picture which may be changed entirely at another point of time. Therefore, the assessment can be only ad hoc or tentative. This will certainly affect validity and reliability resulting in suspicion and criticism. Finally, the problem of constructing tests to assess non-cognitive areas is also very profound. The reason being the absence of one single correct answer to a question like the questions assessing scholastic areas. Apart from this there has been reluctance on the part of teachers to shoulder the responsibility of helping students' growth in non-scholastic areas and assessing them. They believe that it is time-consuming and increases their



workload. The mind-set of the teachers becomes another hurdle in the assessment of these characteristics

Defining non-cognitive area itself is not simple because of its nature and scope. Experts have tried to define terms like personality, attitude, interest, value etc but their efforts have resulted in inconclusive findings. The studies reveal that different researchers arrived at different conclusions. Some researchers use terms such as attitudes, beliefs, values and interest synonymously but to others these are at variance having definite demarcations. This is why the evaluation devices of non-scholastic areas lack scientific rigour. But it is no reason to ignore the area of non-cognitive development. It is imperative that efforts be made to translate concepts like punctuality, discipline, cleanliness, into behavioural terms breaking into behaviour indicators and assessment can be made somewhat easily. "If this exercise is not done it will be like looking for a needle in a haystack without knowing what a needle looks like" (Mehrens W. A; Lehman I J., 1987).

Another difficulty encountered in non-cognitive testing is related to responses. Sometimes students do not give true response. For example, in case of agree or disagree they tend to be neutral. For some items they would like to guess in case they are not sure of the response. The next problem is of social desirability. They would not accept a situation which is not socially accepted.

Closely associated to this problem is faking. It is difficult to get true response from the students if they do not want to divulge it. To combat this situation the items should be constructed in such a way that the faking element could be detected. But one thing is sure — the student will report only that information which he is willing to report. This aspect has to be borne in mind while interpreting the test.

Unlike cognitive tests, the reliability of non-cognitive tests is much lower. The volatile nature of human behaviour does not permit a high rate of reliability in non-cognitive testing. Inconsistency in test responses also creates the problem of low reliability. When low reliabilities are found, one has to be extra cautious in interpreting the difference in scores in a test. In a non-cognitive test only the construct validity can be ensured. However, it is difficult to ascertain predictive validity because of insufficient data.

Interpretation of tests is another very acute problem in non-cognitive testing because they are not like achievement tests where the right answers are fixed. These tests are interpreted in the light of the traits of a normal person in a particular cultural background. Sometimes certain variations may occur in the behaviour of a normal person due to variation in traditions and mores. While interpreting the tests this dimension cannot be overlooked.

As mentioned earlier, most of the responses contain neutral position and

it becomes difficult to draw any specific conclusion. The question is, should these neutral type responses be left completely or be kept as neutral behavioural traits? For this, the opinion is inconclusive. The other problem is concerned with the forced choice items. The scores do not reflect the true feeling of the student because he is forced to choose from the forced choice items. For this forced choice items, some thinkers argue that it may lead to frustration when all the choices are desirable or undesirable.

### Construction of Tests

Construction of non-cognitive tests poses quite a difficult problem on two fronts. One front is concerned with what is to be tested and the other is how it is to be tested. For the question what is to be tested the scope of non-cognitive characteristics has to be defined. The sweep of the non-cognitive areas includes physical, personal social and emotional growth. These areas have specific characteristics. These special features are as follows

1. Behaviours of the children are complex
2. Some behaviours may have a number of components which require more than one instrument of assessment.
3. Assessment of social skills needs making more inferences. Teachers must read the child's behaviour to take the cue for taking a decision.

4. Development of attitudes and values take long to develop, therefore, cannot be assessed at a point of time
5. The assessment of these areas is subjectivity prone because different persons view a personality differently

The next front relates to the ways of constructing non-cognitive tests. There are three approaches of constructing the tests i.e. empirical approach, homogeneous approach, and logical approach. Under empirical approach the framer attempts to develop items that will discriminate students from one group to the other on certain traits. Each item is evaluated in reference to some criterion. In this test the testee cannot fake the response. The constructor uses homogeneous construction approach and tries to prepare a number of items first and then cluster them under identified clusters. These tests have high intra-correlation. For example, different items regarding attitude can be prepared first and then can be clustered into attitude towards school, towards studies, towards teachers and towards school-mates, etc. The approach of logical construction provides for selecting the item on a logical or rational basis rather than empirical basis. The test constructor identifies the traits or skills needed for the task and then prepares items.

So far the importance of development of non-cognitive characteristics, problems related to their assessment and the approaches of constructing the tools

have been discussed. It would be pertinent to discuss assessment of non-cognitive areas at the primary level in Indian schools. The primary level is indisputably the best stage to start assessment of non-scholastic areas as it would lay a sound and firm foundation for the development of non-cognitive characteristics.

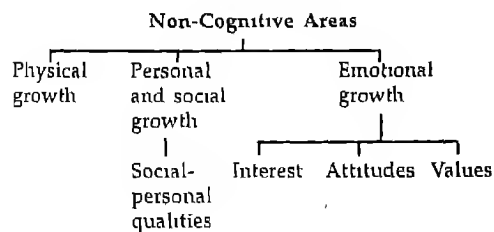
### Assessing Non-cognitive Areas at the Primary Level

The schools need to develop a systematic programme for personality development which has to be included in the school's total programme of evaluation. For this, a well planned programme of assessment involving different steps is envisaged to carry out successful evaluation at the primary level. Following are the different steps.

1. Identifying the qualities
2. Gathering information
3. Recording data
4. Interpreting data
5. Grading the traits
6. Reporting

To begin with, it is necessary to identify and to focus upon the qualities under non-cognitive areas to be tested.

The following flow chart indicates the scope of non-cognitive areas.



A brief discussion of the areas indicated in the above chart may be relevant to the understanding of the question as to what is to be tested in non-cognitive areas.

### Physical Growth

This is a very significant aspect of the personality of the student. Mental health depends on sound physical health. Therefore, it is necessary to educate children in the areas of physical development. For the assessment of physical growth it is advisable that a medical examination is done by a doctor at least once a year. The items to be assessed are height, weight, general health, physical defects and diseases. Cleanliness of teeth, nails, clothes should also be observed by the teacher at this stage.

### Personal and Social Growth

Personality is known by the conduct of a person in a social setting. How he/she thinks, feels, reacts and conducts himself/herself are some of the dispositions which reflect the personality attributes. Personal development directly relates to the development of self. Self covers his/her own special qualities. Self esteem is the measure of one's self concept. It can be high if one sees oneself in a positive light and is satisfied with one's own achievements and accomplishments. He/she considers his/her achievements as his/her strengths and accepts his/her weaknesses also in right earnest. But self-esteem can be low when he/she sees it in a negative light which

may result in frustration, depression and angst. The description of self can be in the context of social acceptance, physical strength, competence and acumen

Social development revolves around the skills of social interactions and inter-personal relationships which provide the base for socialisation of students. Different social skills are required to deal with a variety of social settings. These social skills may relate to adjustment with multiple relationships such as peer group, friends, parents, other relations of the family and other social groups. The qualities like cooperation, tolerance, helpfulness, responsibility, empathy, are essential to interact smoothly in social situations. The absence of these qualities mar the social environment and spoil the peaceful and harmonious ambience in a society.

### *Emotional Growth*

Emotional growth is another very significant dimension of personality as it has tremendous influence on the disposition of personality. Emotional development depicts the abilities to feel, express and regulate one's own emotions. Simultaneously one should be able to identify the emotions of others and empathise with them. In fact emotional growth helps in building an emotionally stable and balanced personality. It covers interests, attitudes and values.

Out of these aforesaid areas identification of certain qualities for non-cognitive assessment is necessary while preparing the assessment programme.

Initially a small number of qualities should be kept as the target to be achieved and assessed. For example, self esteem or self confidence for assessing personal development, one or two interests, attitude towards social issues and some desirable values for assessing emotional development may be included in the programme. Punctuality, discipline, and sharing which are taken into account for the assessment of social development can also be tagged with other aspects.

This will be followed by specifying the behaviours into behaviour indicators of the qualities identified for the purpose of assessment in each growth area. Some of the examples given below from each area of growth might help the teachers to define behaviour indicators so as to enable them to observe correctly.

### **Behaviour Indicators**

#### *1 Personal Growth*

*Self Confidence* : For observing the self confidence in a child various indicators both positive as well as negative have to be observed. These are

- (i) Speaks in a cool manner.
- (ii) Shows composed body gestures.
- (iii) Does not expect help in a tricky situation.
- (iv) Corrects his mistake without getting nervous.
- (v) Does not develop fear psychosis at the time of examination.
- (vi) Encourages self-reliance.
- (vii) Feels nervous in accomplishing a job.

- (viii) Is diffident though capable.
- (ix) Takes responsibility whole-heartedly.
- (x) Takes pleasure in doing a given task.

## 2. Social Growth

### Cooperation

- (i) Helps others in need.
- (ii) Seeks cooperation
- (iii) Keeps aloof.
- (iv) Avoids when asked to help.
- (v) Takes help but does not respond when others need it.

## 3. Emotional Growth

### Emotional Stability

- (i) Shows unhappiness in sorrow.
- (ii) Does not show emotions.
- (iii) Does not feel happy at others' happiness.
- (iv) Does not bother about others' grief.
- (v) Makes fun of others if they are in distress.
- (vi) Controls emotions
- (vii) Does not get perturbed easily.
- (viii) Keeps cool when provoked.
- (ix) Shows high level of tolerance.
- (x) Encourages others to control emotions

Identification of qualities and defining of the behaviour indicators are followed by gathering information. Gathering of information requires different sources, such as the child himself, other children, parents, other teachers, other adults, etc. The observation of these persons can be in various settings for

example outdoors, indoors, with the staff of the school, within family, with stranger, etc. These observations should be made quite meticulously with a purpose.

The next step is recording of data. The gathered information has to be recorded systematically. Recording of data is a crucial step. Many procedures can be adopted for recording data. Some of the procedures are as under.

	Description	Count or Tally	Record of Impressions
1	Narrative	Check list	Rating scale
2	Records	Participation chart	Teacher diary
3	Anecdotes	Frequency chart	
4	Jotting		

Recording data also includes the use of different tools. In the context of tools two important steps are to be taken seriously. One is the selection of an appropriate tool and the other preparation of the right type of tool. Appropriateness of any tool depends on different aspects which entails the details of assessment procedure. In this connection, four aspects need to be taken note of. First is the purpose of assessment, second, type of behaviour being assessed, third, amount of details needed and fourth is the practical considerations.

Keeping these considerations in mind the task of preparing tools could be taken up. A significant problem associated with personality measurement is that paper-pencil tests are not well suited to it. It is because much of the personality has to do with typical

behaviour in actual situations. Only the observation of the behaviour provides clues to the personality traits of the subjects. However, certain tools assessing non-cognitive learning may be selected such as observation schedule, attitude scales, interest inventory checklist, interview, etc. These may be used profitably to assess areas like social- personal qualities, attitudes, interests and values. Of course the selection of the tools will have to be made according to the grades of the children.

Gathering and recording information leads to analysis of data and making judgment. The other important outcome of this analysis might be the use of interpretation to help the growth of children. Interpretation of data related to non-scholastic characteristics should be done continuously. Some guidelines are needed to carry out the interpretation. These guidelines are

1. Adequacy of valid representative sample.
2. Looking for patterns of behaviour instead of an isolated instance.
3. Performance should be accepted as a band not as a specific point on a scale.
4. Keeping broad view of the child.
5. The conclusions should be tentative because children change rapidly. Most of the information cannot be absolutely true at a point of time due to the volatile nature of the behaviour pattern.

The interpretation of data gives way to value judgment regarding the growth of traits in the student's personality. This judgment may be graded on 2- or 3-point scale. It may be mentioned that scoring of these behaviours is not advisable at all. The method of direct grading may be used.

Reporting depends on grading. In fact reporting is the last step of the assessment procedure. Generally it is observed that school report cards lack columns for the reporting of non-cognitive areas. On the contrary there are columns meant to be filled up with the marks of academic achievement only. Schools should get new cards made having enough space for both scholastic and non-scholastic areas. The comments regarding growth must be descriptive so as to familiarise the parents with the strengths and weaknesses of the students. However, negative remarks should be reserved. The comments should only highlight the traits observed with occasional mention of incidents as example.

### **A Brief Outline of Assessment Proposal at the Primary Level**

Delineating from the above discussion a model of assessment in non-cognitive areas at the primary level has been developed. The whole primary stage is split into three levels. The salient features of this model are as follows:

#### **Level I**

Classes I and II : Areas to be assessed

☐ *Physical Growth*

- To be assessed by the doctor once a year.
- If any disorder is observed the teacher will report to the parents immediately.

☐ *Social–Personal Qualities*

- Cleanliness
- Obedience
- Cooperation/aggression
- Self confidence

☐ *Interests*

- Painting
- Music
- Craft
- Sports
- Literary
- Gardening

Interests may be observed during the school programme and co-curricular activities. The teacher should make sure that each child participates in some event or the other in the school programme.

☐ *Attitude*

Both positive and negative attitudes should be seen.

- Towards teachers
- Towards peer group
- Towards school property
- Towards own property

☐ *Values*

At this level values will not be assessed.

*Tools to be Used*

Observation schedule, interest inventory, interview.

*Reporting*

No marks, no grades, only description of the quality being assessed

*Level II*

Class III and IV . Areas to be assessed

☐ *Physical Growth* . Same as above

☐ *Social–Personal Qualities*

- Cleanliness
- Discipline (including obedience)
- Self esteem
- Cooperation—sharing to be increased
- Aggression—should be controlled.
- Initiative

☐ *Interests* . Same as above

☐ *Attitude* : Same as above. Attitude towards studies may be added

☐ *Values*

- Responsibility
- Honesty
- Equality of sexes
- Respect for elders.

*Tools to be Used* : Observation schedule, interest inventory, attitude scale, checklist, interview.

*Reporting* : No marks, no grades. Three point description—always, sometimes, never

*Level III*

Class V : Areas to be assessed.

☐ *Physical Growth* . Same as above

☐ *Social–Personal Qualities* As in level II

☐ *Cleanliness*

- Personal cleanliness
- Keeping surroundings clean to be emphasised more.

☐ *Interests* : Same as in level II

☐ *Attitudes* : Same as in level II

☐ *Values* : Same as in level II.

*Tools to be used* : Observation schedule, interest inventory, attitude scale, checklist, interview, SWOT analysis

*Reporting* : No marks, only grades on three-point scale.

Besides, the teachers can also seek help in their evaluation procedure by employing other devices like role-playing, group work, assignments, project work, etc. These will help evaluate the interests, hobbies, social-personal qualities, etc. of the students.

### Difficulties in Implementation

Time and again efforts have been made to emphasise the importance of the development of non-cognitive learning but it could not take off systematically. The scheme of continuous and comprehensive evaluation got shelved even after becoming a major recommendation of the National Policy on Education, 1986. There are certain practical difficulties. Even a section of educators believe that it is not practically viable. It increases the workload of the teacher. On the one hand teachers are criticised for not putting in optimum effort and on the other, if development of non-cognitive learning is included in the total

instructional plan it is felt the workload of teachers will increase. This paradox needs to be resolved. Secondly, teachers are not well-equipped with regard to the technique of assessing non-cognitive areas. The tools to assess non-cognitive areas are yet to be developed for different levels. Not much research has gone into this area of study. Therefore nothing seems to be conclusive. The educators also feel hesitant in prescribing certain rules and regulations to be observed in the assessment of these areas.

Assessment of non-cognitive learning can be accelerated in Indian schools under the scheme of continuous and comprehensive evaluation provided it is undertaken by administrators, the school management, Principals, and teachers in right earnest. First of all their mind-set needs to be changed with regard to introduction of development of non-cognitive learning with a sense of commitment and conviction. In order to carry out the scheme effectively a well thought out management scheme should also be chalked out wherein Principals and teachers are fully involved. The scheme has to contain a definite time table for the observation and assessment of non-cognitive learning of the students at the primary level. The whole process will be a futile exercise in the absence of proper training and skill development of the teachers. It must be made mandatory to assess non-cognitive areas.



Regarding the capacity building of teachers, orientation programmes on a wider scale require to be conducted so as to make the teachers active partners in implementing assessment schemes of non-cognitive learning in schools. Fear of workload increase has also to be contained through developing understanding, faith and a sense of involvement in teachers. Over and above, trust

has to be reposed in the teachers by the society so that its obsession for criticism and bias may be erased. These efforts probably may yield results for developing non-cognitive learning. The students produced from this system having all-round personality growth would help in making a strife-free, tensionless and humane society.

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# Purpose and Process of Diagnostic Testing

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## Abstract

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*In education, the term 'diagnosis' has been borrowed from medicine. When students' progress is not satisfactory and its cause is expected to be mental it needs to be identified. Once successful diagnosis of learning impediments is done it is followed by remedial teaching. Diagnostic testing is different from achievement testing. Whereas achievement testing is terminal in nature, diagnostic testing could be formative or summative. Apart from describing what diagnostic testing is, the present article also describes what variety of tools and strategies could be used for this purpose. The development of diagnostic tests through different stages is also described.*

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## What is Diagnostic Testing?

**I**N education, the term 'diagnosis' has been borrowed from medicine, where it is used to find out the root cause of a symptom such as fever, pain or malfunctioning of an organ. The diagnosis is followed by the appropriate treatment. The philosophy and purpose of diagnosis in education is the same, though the scope of diagnosis is sometimes broader.

When a student's progress is not satisfactory and its cause is expected to be mental, such as learning capacity, memory, perception, creative ability, comprehension, etc. and personality and temperament dimensions such as attitude, susceptibility, day-dreaming, fears, physical conditions such as physical handicaps and defects, condition of teeth and eyes, muscular strength, co-ordination and school/home environment, it needs to be identified by diagnostic testing and appropriate remedial steps taken. This is not an easy task since establishing the cause and effect relationship sometimes requires a well planned, time consuming and resourceful strategy.

The evaluation in the form of diagnostic testing could be both formative or summative evaluation. At each stage in teaching the teacher makes an assessment of students' achievement which also includes the data about non-achievement. Analysis of this helps to diagnose the needs of the students. This is schematically shown in Fig.1. At each

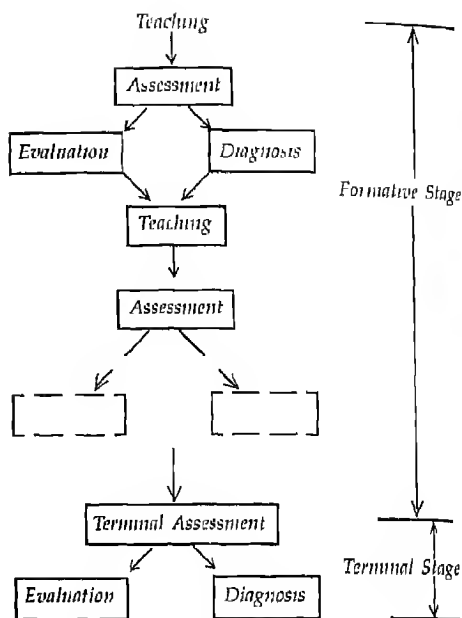


Fig. 1 Scope for diagnosis at different stages

stage of teaching assessment results in evaluation and diagnosis. This is true at the formative stage as well as at the terminal stage. The teaching duration for a stage could be from a few seconds to a few days until further assessment gives rise to another opportunity to make assessment and diagnosis.

Since diagnostic testing could be both formative and summative it could be either formal or informal. The questions asked by the teacher while teaching, designed to find out the learning difficulties, form informal formative testing. On the contrary, at the terminal stage or at the end of a unit, the evaluation conducted is usually formal and summative. During the formative stage

also, sometimes the teacher may feel the need to probe deeply into the cause of a student's response and may conduct formal assessment that includes diagnostic testing. Moreover, the diagnostic testing could be idiographic while looking for the cause of non-achievement in an individual or nomothetic in which data is collected about individuals with a view to generalise the commonality about learning.

Diagnostic test and achievement test are two different types of tests that are developed and used for different purposes. They may appear deceptively similar but are different in many aspects. Achievement test is used to measure the achievement of the learners after a duration of the teaching-learning process. Its purpose is to ascertain the extent and quality of learning. The purpose of diagnostic test is to evaluate and accumulate data regarding non-achievement and its root cause. It could be in terms of existence of alternative frameworks (Driver, 1981), non-existence of assumed previous knowledge and/or skills, or of many other dimensions stated briefly earlier. The conclusions so drawn on the basis of analysis of data collected using diagnostic testing could be used to tailor the future teaching-learning process.

It is relevant to mention here that the process of meaningful diagnosis is not based on one test but the results must be corroborated by different kinds of sources such as rating scale, uncontrolled

observation, questionnaire and interview. Unfortunately, not many ready-to-use tests/questionnaires are available and the teacher would have to design these according to the requirement of the situation.

### The Process of Diagnostic Testing

The diagnosis entails generally five dimensional considerations. These are

1. *Why diagnose?* This includes the reasons that point towards behaviour of the learners for the need to diagnose
2. *What to diagnose?* Deciding, realising, or otherwise coming to an awareness of what one is looking for.
3. *How to diagnose?* Out of the various methods or strategies, selecting a set of procedures to diagnose appropriately. These are the ones that are reliable, valid and feasible to the teacher within his/her resources
4. *How to interpret?* Making sense of testing or observations in terms of cause of the 'original' behaviour that required the need for diagnosing.
5. *How to respond?* With the interpretation of the testing and observation, one needs to take remedial actions. What are these?

For example, a teacher may observe that the students' progress in the unit 'Refraction through Lenses' is not satisfactory and despite many steps taken for effective teaching, students are not responding well. The teacher may decide to look for the root cause of the

problem. There could be various strategies that may be employed for this purpose such as using paper-and-pencil diagnostic test, interview-about-instance and drawing concept map. On the basis of testing, one interprets the cause of poor understanding of the concepts in question in terms of lack of assumed previous knowledge, existence of alternative frameworks, etc. Ultimately, it results in remedial actions to remove learning impediments.

Regarding the dimensions of diagnostic testing, some clarifications are required. This is not to suggest that in all kinds of situations these dimensions would be present, nor are these independent of each other. On the contrary, there could be a good amount of overlapping or relationship between different dimensions. For example, it is possible to visualise a situation in which diagnosing and clarifying the (mis)conception may overlap considerably.

### Tools of Diagnosis

Diagnosis is a multi-dimensional activity with wide implications. However, for the purpose of this article we limit its scope to issues related to teaching of science only, though with minor variations these ideas could be applied to social sciences and language teaching as well. The design of the diagnostic test could be of various kinds. It may be paper-and-pencil type test, making group administration easy. This is the most commonly used and it contains multiple choice type test items (e.g. Hestenes,

Wells and Swackhamer, 1992). Such a test could be used to probe and assess the common-sense beliefs of the students which hamper meaningful learning of a scientific concept. It contains decomposition of the concept into conceptual dimensions for the users' information and a set of test items on each conceptual dimension to be administered on the learners. In another form of test items, apart from making a choice in multiple choice type test item, the student has also to explain the reasoning used by him to arrive at the choice made (e.g. Asian Physics Education 1991; Bell, 1984; Saxena, 1994). The reasoning or the explanation given by the student is analysed to probe and identify the prevailing alternative framework or misconception. In another variation, the question is multi-staged with branching. For example, see the following questions (ASPEN, 1991)

Q1.1 Explain the meaning of 'at rest'

Q1.2 Are there any forces on the box in the figure given below?



Yes (If you answered 'yes' go to Q 1.3 (a) )

No (If you answered 'no' go to Q 1.3 (b) )

Not sure (If you answered 'not sure' go to Q 1.3 (c) )

Q1.3 (a) If you think there are forces on the box, show each force, by an arrow on the box in the figure, and label each arrow

For each of the forces, describe what is exerting the force, what its reaction force is and what is exerting the reaction force

(b) If you think there are no forces on the box, explain why you think so.

(c) If you are not sure whether there are forces on the box, explain why you are not sure

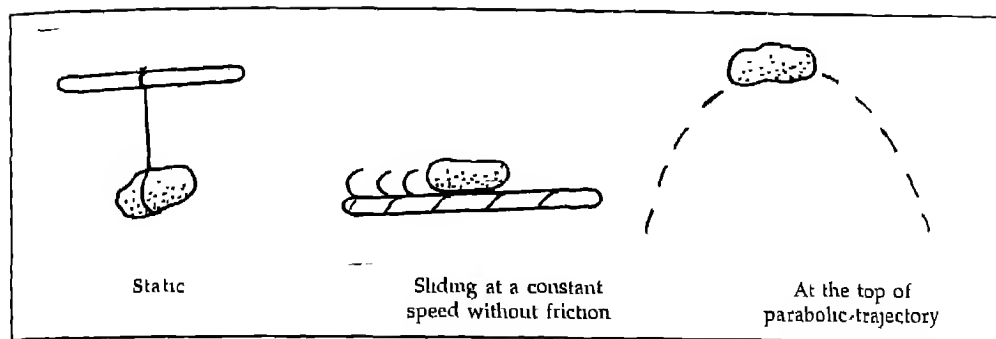


Fig 2 Some of the diagrams used for making free-body diagrams by the students (Whiteley, 1996) redrawn

In other forms of diagnostic tests, a variety of techniques have been used. For example, Whiteley (1996) uses free body diagrams drawn by the students for the purpose of diagnosis. He provided a diagram depicting a situation such as a falling stone and asked the students to show all the forces acting on it. Figure 2 shows a few such diagrams. The responses given by the students are classified to identify common concepts. In another form, Wheeler and Hill (1990) provided the diagrams commonly used in physics literature and the students were asked to interpret them. On the basis of the students' interpretation, the misconceptions generated in the minds of students as a result of using such diagrams are identified.

Concept map is a device discovered by Novak and his colleagues for the purpose of instruction (Novak, 1990). Making a concept map involves putting concept labels on a page and linking them where appropriate with lines to show relationship between them. These lines are labelled with a suitable linking

word, phrase or equation that reveals the proposition(s) that the concept maker sees as linking the concepts. Figure 3 shows one such concept map. Apart from using the concept maps for instruction, those drawn by the students have also been used for the purpose of diagnosis (Austin and Shore, 1995).

In another type of diagnostic test a collection of simple line diagrams are shown to the students and any interview is conducted. Students are required to interpret these as examples or non-examples of a concept, say, force, energy transfer, etc. The students are asked through interview to state their reason and their interpretation. The diagrams do not show a rigid sequence and an informal conversation-cum-interview takes place around the instance presented. Figure 4 shows examples of such diagrams and the technique is known as interview-about-instance approach (Gilbert, Watts and Osborne, 1982; Watts, 1983).

Sometimes a combination of these techniques is also used to investigate

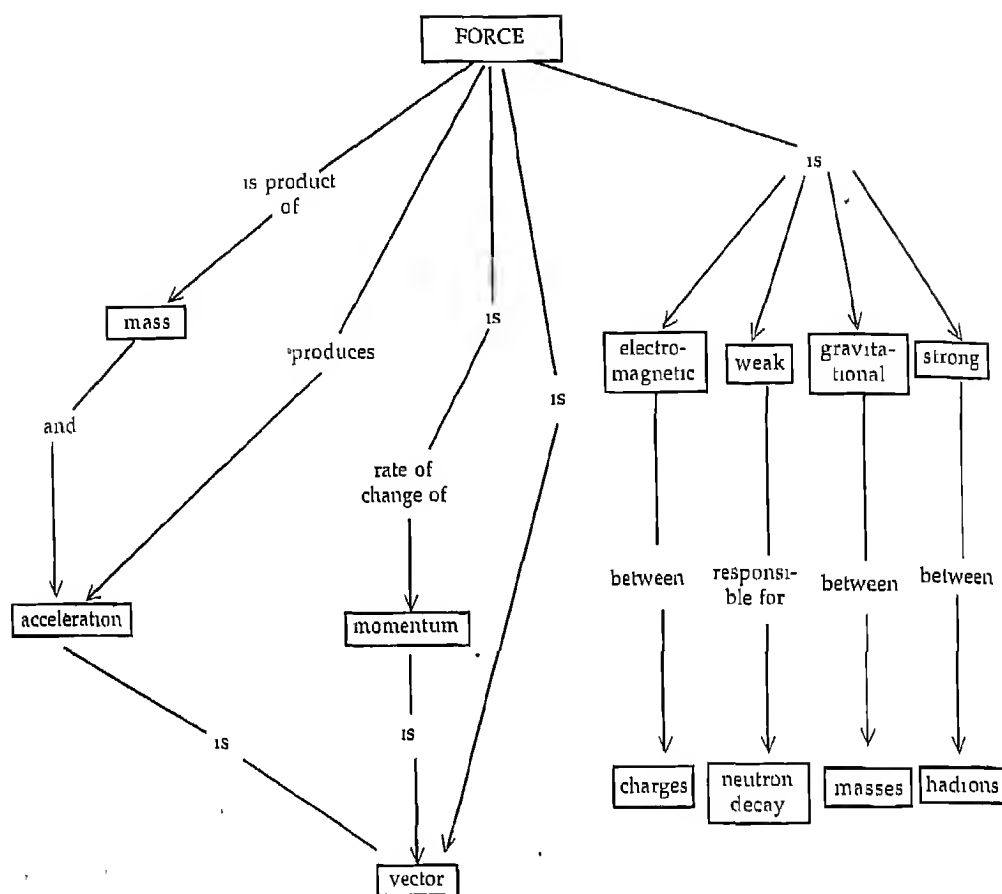


Fig 3 Concept map of force

students' concept. For example, in one approach, at first instance a questionnaire containing multiple choice type questions, also requiring the reasoning to be written, is administered. In the next stage, individual students are interviewed to probe deeper into the ideas expressed. During the interview the actual demonstration of the object/event/process is done (Saxena, 1996).

Sometimes demonstration-based individual interview forms the sole basis of investigation of students' ideas are given. In the demonstration-based individual interview, a simple demonstration serves as the basis of a dialogue between an investigator and a student. The demonstration usually involves real equipment, but sometimes computer simulation is used (McDermott and



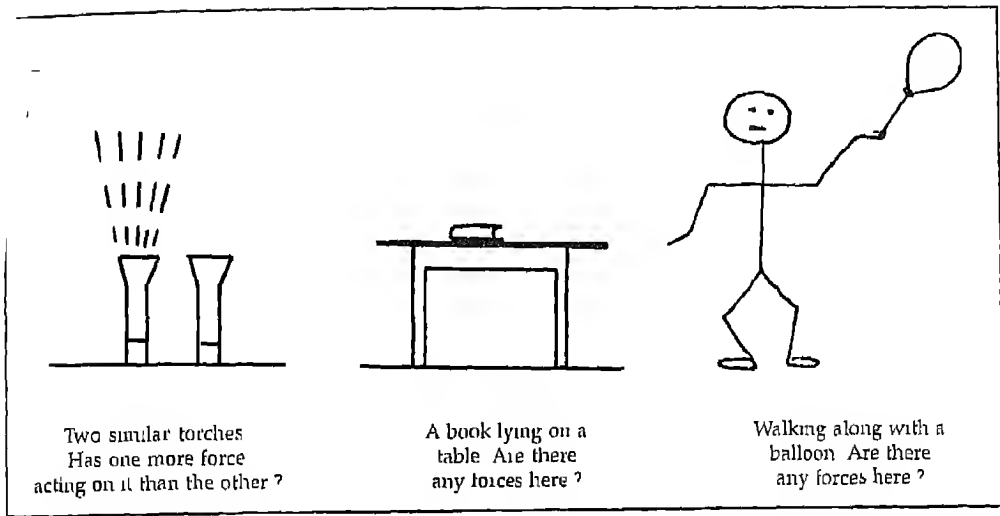


Fig. 4 Example of diagrams for interview about instance (IAI) related to the concept of force (Watts, 1983)

Shaffer, 1992). Through an analysis of audiotaped transcript, specific conceptual and reasoning difficulties are identified. These are further corroborated monitoring student participation in laboratory activities and class discussions. Home assignments provide additional supportive data.

These are various kinds of tools that are used for the purpose of diagnosis and they have their own weaknesses and strengths. However, a typical diagnostic test contains a set of test items. The responses to these, particularly the errors, are of importance for the purpose of diagnosis because they help to identify the weakness of understanding. These could be further investigated if need be. However, the diagnostic test does not reveal the causes of weakness. Next we discuss the development of a typical paper-and-pencil diagnostic test.

### Development of Diagnostic Test

Development of diagnostic test is done through a series of steps. These are shown in Table 1. As a first step the unit

TABLE 1

Development of Diagnostic Test		
Steps		Focus Question
Step 1	Analysis of content	Concepts, examples
Step 2	Development of the test items	Types of questions, situations, concepts
Step 3	Pilot try-out of test	Administrability
Step 4	Analysis of the feedback and revision	Confusing language, diagram, instructions, validity
Step 5	Establish validity	What does it test? Completeness.
Step 6	Establish reliability	Single interpretation, change factor
Step 7	Final version of the diagnostic test	Incorporation of modifications

on which the diagnostic test is to be developed is analysed and the essentials that are to be tested are listed comprehensively in terms of rules, principles, and cognitive and psychomotor abilities. For example, the unit 'Describing Motion' (Madhya Pradesh Textbook 1991) consists of the elements shown in Table 2. On the basis of the content analysis, test items are prepared on each rule, principle and ability. These are influenced by the content element, the kind

of test being prepared and the feasibility of the administration of the test. The test is planned and constructed so that every rule, principle and ability is adequately tested. The first draft of the test so prepared is tried out on a small sample of the target population. The responses are analysed to identify confusing language, diagram, etc. and other weaknesses in the test items. On the basis of the feedback, test items are modified, deleted or new test items are included. Pilot try out thus helps to improve the test at the first instance.

Before the diagnostic test is administered on large scale, it is necessary to check its validity. The content validity of the test could be checked by taking the independent opinion of two or three experts in the content area. In case some test items are found not to test what they claim to they need to be modified. Once the content validity has been established, the test is ready for establishing its reliability. This could be established by administering the test on two similar large samples from the population and comparing the statistical parameters such as average score, standard deviation, etc. for the two samples. If the test has test retest reliability the scores of the two samples would match. Reliability could further be established by comparing the responses given in the test with ideas expressed in individual interviews. It could further be checked that these pre-conceived guidelines are to interpret the responses and each response has a single interpretation only.

TABLE 2

Essential Elements of Unit 'Motion' (MPTC 1991)	
Unit : Motion	
1	Displacement
2	2.1 Rest
	2.2 Motion
	2.3 Relative motion
	2.4 Speed
	2.5 Velocity
	• average velocity
	• instantaneous velocity
3	3.1 Uniform Motion
	3.2 Non-uniform motion
4	Graphical representation of motion
	4.1 Position vs. Time graph for one dimensional motion
	4.2 Interpretation of Position vs. Time graph in terms of velocity
	4.3 Velocity vs. Time graph
5.	5.1 Acceleration
	5.2 Equations of motion
	(i) $v = u + at$
	(ii) $s = ut + \frac{1}{2}at^2$
	(iii) $v^2 = u^2 + 2as$

It is relevant to point out here that the score of an individual student has no relevance in terms of its objectives. Information obtained on the basis of analysis of the responses in terms of alternative frameworks, learning gaps and strengths is the information of real importance. Similarly, the diagnostic test should not be confused with intelligence test or creativity test as they measure different variables. In the final form, the test items in the diagnostic test are generally arranged to facilitate the

analysis and the diagnosis.

In education, diagnostic testing is a multidimensional process that requires well-planned effort on the part of the teacher. When conducted in a systematic manner, it could help to identify and subsequently remove learning impediments. As a result, the learning could turn out to be more meaningful to the learners and satisfying to the teacher. A variety of strategies could be used to diagnose the learning impediments.

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# Skill Development and its Evaluation

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## Abstract

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*Evaluation as carried out in schools is quite restricted in scope, purpose and utility. It rarely goes beyond the scholastic (cognitive) development. The present paper therefore, highlights the need to rectify this imbalance. It further focuses the need to go deeper into the genesis of practical skills, the process of skill development, teaching-learning strategies and evaluation thereby enabling the educators and examiners to appreciate the role of psychomotor objectives in development, instruction and assessment of practical skills. It brings out the need to encourage researches in the area of evaluation of psychomotor skills especially in school settings. Summarising the taxonomies in the psychomotor domain, an effort has been made to present a case for continuous and comprehensive evaluation by using a variety of evaluation devices*

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**E**VALUATION is generally defined as a systematic process of determining the extent to which the instructional objectives are being attained. Carefully designed instructional objectives provide the basis for the measurement of pupils' growth besides helping in maintaining a balance among different aspects of an educational programme. Therefore, a well laid out system of objectives is a must if an educational programme comprising curriculum development, instruction and evaluation is to be valid and effective.

The taxonomical model of educational objectives corresponds to the three primary aspects of a pupil's growth, namely, cognitive (knowing), affective (feeling) and psychomotor (doing). While cognitive development, by and large, has been adequately addressed in our scheme of instruction and evaluation, the other two inter-related aspects, namely, affective and psychomotor have grievously suffered mainly due to the overemphasis on teaching for the so-called glorious cognitive objectives like critical thinking and problem solving without caring for emotive reaction or attainment of neuro-muscular coordination.

There is an urgent need to rectify this imbalance by developing among students an insight into the attitudes and skills which would require a clear emphasis on process objectives. Following NPE 1986 the school curriculum included some predominantly skill-oriented subject areas like work education, vocational

education, physical education, art education, computer education and practical instruction included in science and commerce. It is a fact that the present system of examining students in these skill-dominated subject areas is far from satisfactory. An analysis of the existing system as implemented in classrooms will reveal an undue emphasis on knowledge and functional understanding rather than on skill development. Practical examinations focus on finished product rather than the process of performance. Scoring is largely impressionistic instead of criterion based.

Seen in this backdrop there is a need to go deeper into the genesis of practical skills, the process of skill development, accompanying teaching-learning strategies and evaluation so that the educators and examiners are able to appreciate the role of psychomotor objectives in development, instruction and assessment of practical skills.

### Meaning of Skill

The dictionary meanings of the word 'skill' are (a) ability to do expertly and well, (b) expertness, practised ability, dexterity, facility in doing something, (c) practical knowledge in combination with ability, cleverness, expertness, (d) special ability in a particular field especially acquired by learning and practice, and (e) the familiar knowledge of any science, art or handicraft as shown by dexterity in execution or performance or in its application to practical purposes. These meanings indicate that 'skill is the practical

ability to perform any task with expertness, dexterity, mastery and efficiency' (Sen Gupta, 1993). Ian Winfield (1988) defined skill as any series of mental or physical acts executed in such a way as to demonstrate complete control by the executor.

Such complete control would obviously require a well coordinated activity on the part of the executor involving different senses, mental abilities and muscular movements. In other words skill involves chains of movements, involving mainly the eye-hand coordination, executed in a particular sequence. A skill achieves its effect with economy of time, effort and resources. In the process of its development knowledge and skill cannot be sharply distinguished. According to Mills (1977) sound theory is sound practice conscious of itself, and sound practice is sound theory unconscious of itself. Thus, psychomotor abilities of performing a skill often merge with the cognitive abilities of knowing and understanding. Psychomotor skills in the present context will include manipulative and observational skills as also skills of selecting, identifying, drawing, estimating and reporting.

### **Development of Skill**

Development of intellectual and manual skills in a harmonious manner is essential for pursuit of excellence. While theoretical instruction is mainly responsible for developing concepts and generalisations, these get crystallised through doing or practical manipulative work.

Gandhi believed in the development of 'thinking fingers' through manual work done intelligently. According to him working with the hand and thinking with the brain should go hand in hand in any developmental task. In fact these two processes are not mutually exclusive. When these two function separately in a society, it gets divided into intellectual and manual workers. A progressive society opts for a judicious merging of these two so that the pain and drudgery of a worker gives way to joy of work, economy of time, effort and physical and human resources. In the process of developing a motor skill not only are the muscles trained but also the perception.

### **Learning of Skill**

An urge to learn and improve at successive stages is basic to skill learning. Without a deliberate intent to learn and improve, merely going through the motions in a mechanical manner does not ensure learning. Three distinct phases can be discerned in the process of learning a skill viz cognitive phase, fixation phase and autonomous phase. During the cognitive phase, the learner tries to visualise or intellectualise the skill to be performed. The instructor at this stage defines the objectives, specifies what is to be done, demonstrates the sequence of operations and instructs how to proceed. He also lets the students know the likely errors and pitfalls in the process. Safety measures to be adopted are also specified. Thus in this phase the learner is able to analyse the skill, acquire knowledge about the

operations and their sequence thereby visualising the pattern of movement as a whole. In the fixation phase, following systematic instruction and demonstration the learner practises the skill in parts. The skill gets perfected through repeated practice for a considerable period of time along with reduction of incorrect responses to minimum or zero. Increased speed of performance is an essential factor in the acquisition of productive skills. The autonomous phase is thus characterised by increase in speed which gradually leads to further control and precision in performance. In the final stages of this phase doing becomes involuntary and movements autonomous.

### Strategies for Instruction

Skill learning requires a calm and unhurried atmosphere. Effective skill teaching on the other hand requires sequential presentation of subject matter in a practical and lucid manner. Using lots of verbalism without using the senses is the least effective way. In transacting a skill lesson a short introductory talk relating present lesson to previous knowledge of students precedes the step-by-step presentation of the skill. Demonstration plays a significant role in skill development. A skill should be demonstrated slowly, pointing out the likely mistakes and pitfalls, giving safety precautions to be observed, involving learners' participation and providing immediate feedback. The demonstration is to be closely followed by practice by the students under active guidance of the teacher. Every effort

should be made to integrate knowledge and skill or thinking and doing for ensuring progressive improvement in accomplishment. A non-competitive, cooperative and mutually helping classroom climate is most conducive to skill learning. Competition between the groups and cooperation within the group may be a good dictum to follow for optimum results.

### Evaluation of Skill Development

In order to appraise the multisensory development of pupils, practical work or work practice is used as a testing device. In our assessment scheme, particularly at the school level, evaluation of skill learning is generally relegated to the secondary position. Passing in these examinations is almost taken for granted both by students and teachers. In fact almost hundred per cent pass percentage in practicals and that too with much inflated scores help in boosting the average score of the subject. Product of performance is over-emphasised and the scoring in most cases is subjective. It will not be an exaggeration to say that the evaluation of psychomotor skills has not been adequately addressed in school education. There is a dearth of worthwhile researches in this area especially in school settings. There is therefore, a definite need to encourage researches in this field to empirically establish how best the skills can be developed and evaluated more scientifically. In this context, Singh (1983) maintains that "during



the last two decades some theoretical frameworks have been put forward by Simpson (1966), Alles (1967), Dave (1971), Harrow (1972) and Hanna (1975). Nevertheless, the work in this field has only been limited to certain niches and has not yet become a dogma the followers of which can boast of.

Evaluation of skill development involves an appraisal of both process and product. Process of performance may be judged through observation and records in terms of time taken, amount of wastage, use of appropriate techniques, perseverance, punctuality and initiative. Raizada (1995) mentions the main characteristics of expert performance as—a steady and uniform flow of motion, easy and economical movements, relaxed performance, concentration upon the task and intelligent use of the senses. Similarly, in a productive activity, a finished product may be judged as excellent or best if it has been accomplished in minimum time, with minimum labour and wastage of resources and fulfils the safety criteria even above the market price. Due weightage should be given to inputs of imagination, originality and persistence on the part of the performer.

Fleishman (1956) identified the following motor abilities in the learning of skills.

- (i) *Reaction time* : speed with which the learner can respond to an expected stimulus
- (ii) *Tapping ability* : speed with which one can perform a rapid movement

- (iii) *Manual dexterity* : ability to make skilful, controlled arm and hand movements at a rapid rate
- (iv) *Finger dexterity* : rapid manipulation of objects with fingers
- (v) *Psychomotor precision* : speed with precision in eye-hand coordination
- (vi) *Steadiness*
- (vii) *Motor kinesthesia*
- (viii) *Psychomotor speed*

Singh (1983) has mentioned a number of taxonomies of psychomotor domain which indicate categorisation of objectives relating to this domain. R.H. Dave (1971) classified the objectives as imitation, manipulation, precision, coordination and naturalisation. Simpson (1966) gave six objectives, viz. perception, set, guided response, mechanism, complex-overt response, adapting and originating. These objectives are arranged in hierarchical order. Perception includes sensory stimulation, cue selection and translation. Set includes mental set, physical set and emotional set. Guided response relates to imitation and trial and error. Hierarchical act and patterning of response are included in mechanism. Complex-overt response includes resolution of uncertainty and automatic performance. Adapting and originating as the terms indicate relate to improvising and modifying patterns.

Yet another taxonomy by Hannah and Michaelis has five objectives arranged in hierarchical order. These

are imitating, patterning, mastering, applying and improvising. Imitating relates to the natural tendency of imitation. The learner at this stage observes, remembers, copies and then reproduces the elements of the skill as demonstrated by the teacher. With more and more guided practice he moves to the next stage, i.e. patterning. The learner can now execute the skill independently without the teacher's assistance. He can blend the steps. The learning time progressively gets reduced. However, skill execution is still slow, inconsistent and lacks total precision. Execution becomes more precise at the mastering stage. Through repetitive practice the learner gains proficiency and performs at an appropriate speed, his movements become precise, coordinated and automatic. Now onwards he is able to apply the skill in new situations with speed and accuracy. Finally, the ultimate stage is reached in the process of developing skill when the learner is able to modify, adapt or introduce new elements and use the skill creatively with flexibility in new situations.

In a comprehensive evaluation scheme the emphasis should be on testing of skill attainment by the learner and not on mere acquisition of knowledge of skills. A variety of evaluation devices will have to be judiciously used to test knowledge, skill, application and the personality traits of the learners. These may include oral test, written test, performance test and observation/inter-view techniques. In any skill appraisal,

physical responses gain much more significance than mental responses as it involves dexterity, expertness and practiced ability.

Presented in the next page is a tentative scheme of evaluation for skill learning. The example has been drawn by adopting Simpson's categorisation of objectives related to the psychomotor domain.

At the end of skill learning a summative test designed for assessing the attainment of all the objectives may be given.

A perusal of the foregoing suggests that while evaluating skill learning one must take into account the various types of component skills involved. During the instructional programme these component skills will have to be developed in sequence. Evaluation in the area of skill development cannot be a one-time affair. Appraisal of skills learnt will have to be done continuously as a part of the instructional programme. Besides continuous evaluation aimed at judging the component skills, periodic internal or external examinations are also recommended for making an assessment of the integrated skills.

Once the hierarchical nature of skills and the key abilities related to each stage are clearly understood a suitable instructional design can be evolved to develop them. It is only then that evaluation can be geared to the assessment of all such skills and abilities. Every effort should be made to ensure a valid and reliable evaluation programme which is

Objectives	Alternative Procedures	Tools for Evaluation
(a) <i>Perception</i> to test awareness about object, quality etc	- written test - oral test	(i) written test (ii) list of questions for oral testing
(b) <i>Set</i> to test physical and mental readiness	- observation - interview	(i) observation schedule (ii) interview schedule
(c) <i>Guided Response</i> to test the improvement in students	- observation	(i) observation schedule (ii) check-list
(d) <i>Mechanism</i> to test the patterning of responses	- oral test - observation	(i) list of questions for oral testing (ii) observation schedule (iii) check-list
(e) <i>Complex-overt Response</i> to test the automatic performance and uncertainty	- oral test - observation - rating	(i) observation schedule (ii) rating scale (iii) list of questions for oral testing
(f) <i>Adapting and Originating</i> to assess the original ideas	- observation - rating	(i) observation schedule (ii) rating scale

continuous as well as comprehensive so that it provides diagnostic data about strengths, weaknesses and interests of students. The evaluation programme so

designed should be objective in assessment, include the qualities of practicality and simplicity and also help in motivating learners to further learning.

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# Judging the Quality of Criterion-referenced Tests

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## Abstract

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*For construction of a good criterion-referenced test, certain aspects of preparation should be given attention. Analysing the test items and judging their quality with regard to purpose and interpretation of test scores will better serve the purpose of evaluation in schools. Unlike norm-referenced tests, in criterion-referenced tests the facility index is the indicator of teacher effectiveness. In case of poor performance, the item need not be rejected as this indicates teacher ineffectiveness. The discrimination index is the difference between the proportion of masters who answer the item correctly and the proportion of non-masters who answer the item correctly. Due to low variance of scores, instead of correlational techniques, percentages of students' scores in two testing occasions are compared. Content, construct and criterion-related validities can be calculated for the criterion-referenced tests but correlational methods do not work very well due to homogeneous score distribution.*

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**C**RITERION-referenced tests (CRTs) are gradually making their place in the norm-referenced test (NRTs) dominated students' evaluation. There are a number of ways to judge the quality of norm-referenced tests. Some may be empirical some experimental and some statistical. For judging the quality of criterion-referenced tests one must know various techniques of judging the qualities of a criterion-referenced test. Like the norm-referenced tests item analysis is an essential technique of judging the quality of criterion-referenced tests. The following qualities are described below for a test.

1. Facility Index
2. Discrimination Index
3. Reliability
4. Validity

### Facility Index

The facility index or difficulty level in CRTs (mastery tests) has a different meaning from those of NRTs (discrimination tests). Difference among examinees at all ability levels is not important in such tests. It is the distinction between those who pass (masters) and those who fail (non-masters) which is important since skills to be tested in CRTs are generally basic skills. It is expected that a high percentage of students master them. In norm-referenced tests the facility index is generally kept upto 80 and items having index more than 80 are rejected. The facility index in CRTs

can go up to 100 because in CRTs the facility index is the indicator of teacher effectiveness. Thus a teacher who discards an item with more than 0.80 as facility index in discriminating tests (NRTs) should not be disturbed by a facility index of 0.80 or more in such tests. In fact the teacher should feel encouraged because a large proportion of students have mastered the skills or the concepts tested in the examination. This reflects indirectly the teacher effectiveness. The maximisation of variation among examinees is irrelevant to the purpose of such a test, therefore there is no statistical basis for an ideal facility level. Facility indexes normally vary from 0.80 to 1.00 in CRTs in contrast to 0.20 to 0.80 in NRTs. The facility index of CRT is 10, 15, 20, 40, or even 60 or 70 which shows students have not yet mastered that domain and concept and need remedial action on part of the teacher. In case of poor performance, items cannot be rejected. This indicates teaching effectiveness or ineffectiveness.

### Discrimination Index

Discrimination index is calculated on the basis of differences in the proportion of students attempting an item correctly from the upper (25 per cent or 50 per cent) and the lower group (25 per cent or so) to account for maximum variation. As such it is only at 0.50 difficulty level (facility index) that the discrimination of 1.00 is possible. In case

of CRTs the items are passed by high (80 per cent or more) proportion of examinees and as such discrimination expected in case of CRTs is much lower than those of discriminatory tests. In fact the focus of CRTs is on minimisation of gap between high achievers (masters) and low achievers (non-masters). Therefore, discrimination index cannot be expected

Scannel and Tracy (1975) recommended the following method: "Criterion-referenced tests are not expected to discriminate among all levels of competence but only between those who pass (at mastery level) and those who fail (non-masters)". Therefore, instead of comparing performance of an item, on the basis of highest and lowest 25 per cent of students we can compare the performance of 'masters' and 'non-masters' by putting all failures (non-masters) in the lower group and those who pass (masters) in the upper group. Discrimination index then can be defined as the difference between the proportion of passing examinees who answer the item correctly and the proportion of failing examinees who answer the item correctly by using the formula

$$\text{Discrimination Index} = \frac{R_p}{np} - \frac{R_f}{nf}$$

$R_p$  – Number of examinees who passed the total test and answer the item correctly

$R_f$  – Number of examinees who failed the total test and answered the item correctly

$np$  – Number of examinees who passed the total test

$nf$  – Number of examinees who failed the total test

An example

Response	Passed	Failed	Total Examinees
Correct	35 $R_p=35$	7 $R_f=7$	42
Incorrect	3	5	8
Total	38 $np=38$	12 $nf=12$	50

$np = 38$   
 $nf = 12$

$R_p = 35$   
 $R_f = 7$

Since the formula for Discrimination is

$$\text{Index} = \frac{R_p}{np} - \frac{R_f}{nf}, \text{ therefore,}$$

$$\begin{aligned} \text{Index of Discrimination} &= \frac{35}{38} - \frac{7}{12} \\ &= 0.33 \end{aligned}$$

Thus, the proportion of passing students who answer the items correctly exceeds the proportion of failing students answering correctly by 0.33

### Reliability

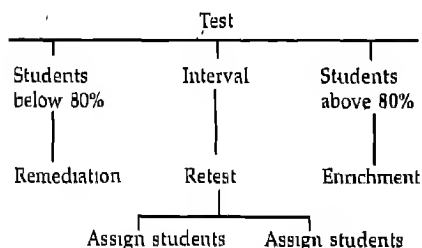
Reliability in CRTs is as important as in NRTs. Popham and Husek (1969) first pointed out that the internal consistency of the CRT scores are more important than the correlation techniques. The test score reliability depends on test score variability, equivalence and

internal consistency that can be used as the measures of reliability in CRTs.

Low range of variance results from homogeneously high performance of the students. This calls for attention to distribution of responses under analysis. Therefore, less sophisticated but more meaningful reliable estimates are available. Instead of correlational techniques we can simply calculate the percentage of students' scores that were different on two testing occasions, by say 0-5, 6-10, 11-15, per cent.

For internal consistency, analysis may be focussed on one set at a time i.e. set of items belonging to a single domain, and never a married one (Popham).

Calculate percentage of identical assignments on two occasions to find the reliability estimates as depicted in the following flow chart



Carver (1970) prepared two procedures for assessing the reliability of criterion-referenced tests. First : Administer the same test to two comparable groups and compare the percentage of examinees who were classified as masters. Second : administer two parallel tests to the same group, and compare

the percentage of 'masters' in the two tests

With each procedure, the more comparable the percentage, the more reliable the tests are said to be. Craver (1970) rejected a correlational approach to reliability and emphasised reliability depends on replicability. His procedure was based on replicability of distributions.

### Factors Affecting Reliability of CRT

- (i) Test medium may cause problem of reliability due to ambiguity in the language used, use of pictures, diagrams, maps or table of data
- (ii) Sampling procedure is another source of error resulting from selection of items while sampling in an open or close domain tests.
- (iii) Pupil error may affect reliability because he/she may do an item at one point of time but miss it the next time and make a mistake in spite of the fact that he/she might have mastered it.
- (iv) Guessing, particularly in multiple-choice items affects reliability. This can be minimised by including more items from each domain.
- (v) Inappropriate criterion score, i.e., the number of items a pupil is expected to answer correctly to declare him successful (master) is quite arbitrary. This may lead to unreliability because for a certain proportion of students who are



declared as masters (or non-masters) the interpretation may be invalid. This aspect is really problematic as it is difficult to establish criterion score.

Thus, an attempt has to be made to prepare different groups of items, each group sampling only one domain. Each item should be carefully written to avoid language and other ambiguities. There should also be a number of items testing each domain. As far as establishing the appropriate criterion score is concerned, it is indeed problematic. Suppose we take even 50 per cent (not 33-40 per cent) as pass score it is only an estimate of the pupil's true mastery of the domain. If we assume 20 per cent as unreliability score (of course, pessimistically) say, on a 10 item open domain test on the concept 'food chain', this would be attained only by a student who attempts correctly 70 per cent of the items but gets two items wrong because of test unreliability. Another student who gets 50 per cent due to luck is not good for diagnostic assessment because the possibility (50-20=30 per cent) is there that he does not have much idea of the concept of 'food chain'. On the other extreme if we fix 80 per cent or 90 per cent, not 50 per cent, as criterion score and assume the same 20 per cent unreliability element, the students who attempt correctly 80 per cent or 90 per cent of the items are likely to fail. Therefore, a compromise is made by

setting an arbitrary score of 70 to 75 per cent.

### Validity

Test score validity can be defined as the accuracy with which the scores from the test can be used to achieve a stated purpose (such as making inferences about examinees' domain score performance or assigning examinees to mastery level). It is important to recognise that validity refers to the appropriateness of particular uses of scores obtained from a test and not specifically to the test itself (Linn, 1979,1980).

Many contributions to criterion-referenced testing literature have been made since the late 1960s. The important topic of criterion-referenced test score validity has received limited attention from researchers. Only a few researchers have attempted to define the nature of validity with CRTs and to identify problems encountered when validating the use of CRTs or to offer guidelines for validating criterion-referenced test scores.

Very often, measurement specialists assume the validity of criterion-referenced test scores rather than make a special effort to establish the validity of the scores in any formal way. The argument seems to be that if appropriate development steps are carried out, a valid CRT will necessarily result. A review of twelve criterion-referenced tests reveals that the items matched the objectives. No evidence of the accuracy of

the domain scores or of 'mastery' and 'non-mastery' classification was presented. Of course, researchers will need to validate the use of the test scores with each new examinee group (Millman, 1979)

### *Content Validity*

Many criterion-referenced test developers want to validate their tests and test scores with content validity. Here, the judgements are obtained from persons with content expertise concerning the match between test content and the objectives of the test designed to be measured. The content validity of a test does not vary from one sample of examinees to the next nor with time. The content validity of the test does not depend on the speed of test construction. The content validity evidence is not sufficient to establish the validity of the intended uses of the test scores with a particular group of examinees.

The major problem is that content validity is focussed upon test forms rather than test scores, upon instruments rather than measurements. Inferences in educational and psychological measurements are made from scores, and scores are a function of subject responses. Any concept of validity of measurement must include reference to empirical consistency. Content coverage is an important consideration in test construction and interpretation, to be sure, but in itself it does not provide validity. Linn (1979) made a similar point. Issues of validity are related to the

soundness of the interpretations of a measure. Thus, it is the interpretation rather than the measure that is validated. Measurement results may have many interpretations that differ in their degree of validity and in the type of evidence required for the validation process. Fortunately, there are a number of methods that can be used to gather validity evidences relevant to the intended uses of a set of test scores.

1. *Intra-objective Method* : It includes item-analysis, the evaluation of test content (determination of item and content validity) and score reliability
2. *Inter-objective Methods* : It includes what are called 'convergent' and 'divergent' validity studies. These studies determine whether the test scores correlate with the variables they might reasonably be expected to relate to, or if the test scores are uncorrelated with the variables they should not be related to
3. *Criterion-related Methods* . It includes prediction studies and studies of the relationship between test scores and independent measures of performance.
4. *Experimental Method* : It includes determining the sensitivity of tests scores to the effect of instruction on test content.
5. *Multi-trait/Multi-method* . It is related to ensuring multi-level validity of a

test. Of course, accumulating validation evidences is a never-ending process. The multi-level validity depends upon two factors. One, the amount of time and energy spent on the process. Second, the relevance of the testing programme.

Consistent with the new technical standards, the validity of the test scores will need to be established within a general framework that contains three components : content, criterion-related, and construct validity. A brief discussion of these follows.

1. *Content Validity* The content validity of a test is determined by judging the representativeness of the test items of a specified domain of content. In order to ascertain content validity the two requirements are

- i) a clear statement of the content domain
- ii) detailing of the sampling plan used in the item selection

In fact the set of items should be broadly representative of the content domain of interest.

Another procedure for assessing content validity is to carry out Cronbach's duplication experiment. His experiment requires two teams of equally competent item writers and reviewers to work independently in developing a criterion-referenced test. If the domain specifications are clear, and if item sampling is representative, the two tests should be equivalent.

Equivalence of forms can be checked by administering both forms to the same group of examinees and comparing the two sets of examinee test scores. A feature of the procedure is that content validity can be described by a statistic

2. *Construct Validity* . Construct validation studies are not common in criterion-referenced measurement. This may be because criterion-referenced test scores distributions are often homogeneous. Correlational methods do not work very well with homogeneous score distributions because of the problems due to score range restrictions. Construct validation is by no means limited to correlation coefficients and are prevalent in internal consistency indices. Construct validity evidence cannot be reported in the form of a single statistic, but with a substantial amount of evidence.

3. *Criterion-related Validity* : The scores derived from the criterion-referenced tests cannot be used as predictors of, say 'job success', or success in the next unit of instruction. Further, in the instructional settings, simply by basing on criterion-referenced test scores and deciding masters/non-masters, the decision for the subsequent unit of instruction cannot be predicted. Such a prediction is not appropriate either. So investigation is to be done before assigning the future units without regard for their past performance.

Besides, two relatively new types of validity, curricular and instructional,

have been discussed and recommended in the psychometric literature. Curricular validity refers to the degree to which the items in the test match the objectives of the school curriculum in which the students are accounted for. When the objectives of the school curriculum coincide with the objectives of the test, the content validity and curricular validity become identical. When the two sets are different, curricular validity studies can be carried out separately. The method of doing this involves reviewing curriculum objectives, textbooks, communications of expectations of the students, time allocated to the segments of the courses, etc.

Instructional validity refers to the degree of match between the objectives

measured in a test and the objectives that were actually taught to students in the schools. There are a number of techniques for assessing instructional validity. Their techniques include classroom observations, review of instructional materials, self report of instructors and interviews with students.

To sum up, it can be concluded that quality concerns are equally important for criterion-referenced tests as for norm-referenced tests; merely following the criterion is not important. Ascertaining the reliability and validity together with difficulty and discrimination indices for criterion-referenced test following the various methods suggested will certainly enhance the scope of the use of multiple testing techniques.

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# Teachers' Evaluation of Students' Change of Learning

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## Abstract

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*Teachers require knowledge of various statistical techniques for determining change in students' learning. Usually, these techniques are cumbersome and time consuming. In the present paper an attempt has been made to expose teachers to simpler and less cumbersome statistical techniques of ascertaining the significance of change in students' learning. The techniques discussed here are t-test, McNemar test and its extension and elementary linkage analysis.*

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**S**CHOOL processes are mainly concerned with the development of cognitive, affective, and psychomotor intents of the students. Cognitive theorists as well as epistemological constructivists assert that learning is a developmental process. This view on learning should then be evaluated<sup>1</sup> through change related to a domain of knowledge.

A teacher's major job in the classroom is to transact the given curriculum to a target class, so that the instructional intents leading to course goals are effectively realised. However, mere assessment of the instructional intents qualitatively or quantitatively is inadequate. The change of students' learning concerns evaluation, i.e., whether a significant change has occurred or not. It has been also asserted that the teachers should do remedial teaching. The basis of such an assertion is that generally the instructional intents remain inadequately realised. Adequacy of intent realisation can only be evaluated by applying a suitable statistical technique that confirms significance of change.

There are many statistical techniques available in the literature which lend support for determining change in students' learnings. School teachers report that these statistical techniques are not only cumbersome but time consuming as well. Hence, teachers have been avoiding them for arriving at empirical decisions. This perception of the school teachers does not seem to be unfounded. Even the simple one-group pre-test/

post-test design requires the use of the correlated 't' for evaluating the significance of change. The author feels that the school teachers should be exposed to simpler and less cumbersome statistical techniques that would help them ascertain the significance of change in their students' learnings.

### 't' Test

Change in students' learning can be easily determined by employing the *t* test that utilises the difference of the two sets of raw scores. The following example is suggested for this purpose.

### Example

A group of third graders was given an arithmetic test (X scores) and also one at the end of an intervention programme (Y scores). Did the third graders improve in the arithmetic test after the intervention programme?

Pupils	First Test Scores (x)	Second Test Scores (y)	Difference D (y-x)	D <sup>2</sup>
1	38	32	-6	36
2	40	48	8	64
3	69	78	9	81
4	38	37	-1	1
5	36	42	6	36
6	60	71	11	121
7	53	62	9	81
8	74	80	6	36
9	39	43	4	16

N = 9

$\Sigma D$

46

$\Sigma D^2$

472

To calculate the significance of change, the following formula is used.

$$t = \frac{\sum D}{\sqrt{N \sum D^2 - (\sum D)^2}}$$

where D = the difference between the scores X and the scores Y

$$t = \frac{46}{\sqrt{9 \times 472 - (46)^2}}$$

$$= 2.93$$

t to be significant at 5 per cent level of confidence with d f of 8 (N-1) is 2.036. Our calculated value exceeds it (t = 2.93), therefore, it is significant.

### Inference

Third graders had improved their arithmetic performance significantly after the intervention programme.

### The McNemar Test for the Significance of Change

Many a time, the school teachers' data regarding a variable has ordinal scale properties. Then the McNemar test for the significance of change is an appropriate statistical technique (Cohen, 1976).

### Example

Fifth grade children (N=50) were administered an understanding of science test. One class period was employed for a week to remove students' misconceptions. After three days, a test of understanding of science was again administered.

Do the fifth graders show significant change in understanding of science after a week's interaction?

The increment (change) in understanding of science can be worked out by the following test.

$$\chi^2 = \frac{(1A - D1 - 1)^2}{A + D}$$

First *before* and *after* change in understanding of science is to be constructed in the 2 × 2 matrix.

		After	
		-	+
Before	+	A 8	B 10
	-	C 7	D 25

- A – All those subjects who regressed after a week's clarification of misconceptions
- B – All those subjects who did not improve before and after one week's intervention
- C – All those subjects who failed before and after intervention programme
- D – All those subjects who failed before intervention programme and subsequently improved their performance

Putting the values A and D in the formula we get

$$\chi^2 = \frac{(25 - 8 - 1)^2}{33}$$

$$= 7.75$$

With  $df = 1$ ,  $\chi^2$  value is 3.84 at 5 per cent level of confidence. Obtained  $\chi^2$  is 7.75, hence, it is significant.

### Inference

One week's classroom interaction on misconceptions of the students significantly changed their understanding of science.

Although the above inference has been drawn on the basis of empirical judgement regarding the significant change on understanding of science by the fifth graders after a week's interaction on misconceptions, yet, in this kind of empirical decision, one point that needs examination is whether students showing positive or negative attitudes towards science have contributed significantly in understanding of science after a week's instructional intervention. To check for this kind of anomaly, it is suggested to run two chi-square tests, i.e., one for the positive attitude holders and the other for the poor (negative) attitude holders.

Below have been created two  $2 \times 2$  matrices hypothetically for knowing whether positive/negative attitudes of the fifth graders towards science have

		Group A (positive attitude group, $N = 50$ )	
		After	
		-	+
Before	+	A 8	B 10
	-	C 7	D 25

		Group B (Negative attitude group, $N = 50$ )	
		After	
		-	+
Before	+	A 7	B 8
	-	C 10	D 15

affected understanding of science after receiving a week's intervention.

### Calculated Values of $\chi^2$

Group	$\chi^2$	P
A	7.75	Sig
B	2.31	ns

For  $df = 1$ ,  $\chi^2$  value to be significant at 5 per cent would be 3.84

### Inference

Fifth grade children having positive attitudes toward science have significantly improved their performance on understanding of science after a week's intervention programme. Children with poor attitudes towards science did not improve their performance on understanding of science after a week's intervention programme.

### An Extension of the McNemar Test for the Significance of Change

Teachers have to maintain records of non-cognitive measures also of their students' progress. Therefore, an example has been worked out to show how a teacher may determine significance of change on a non-cognitive measure (attitudes towards science).



*Example*

Class (N=100) was given an attitude test (it was a seven-point semantic differential scale One being useless and seven being useful, intervened by 6,5,2 and 3, 4 is neutral position) in July and in April of the next academic session

Does the class show significant change in attitude towards science?

This extension of McNemar's test first needs creation of the matrix as shown below.

*Matrix* : Obtained on the basis of semantic differential ratings from one to seven.

	Useful	7	6	5	4	3	2	1	Useless
Area A 7		2	7	5	1	0	0	0	Area D
6		6	4	18	13	0	0	0	
8		5	5	3	3	20	3	0	
1		4	0	1	0	5	0	0	
4		3	0	0	1	3	0	0	
19		2	0	0	0	0	0	0	
Useless 1		0	0	0	0	0	0	0	⇒ 14

Area D - Favourable change, sum of the scores in this areas (13 + 31 + 23 = 67)

Area A - Unfavourable change, sum of the scores in this area (6 + 8 + 1 + 4 = 19)

The diagonal represents no change (2 + 4 + 3 + 5 + 0 + 0 + 0 = 14)

Change is calculated by the following formula.

$$t = \frac{|A - D|}{\sqrt{A + D}}$$

$$= \frac{|19 - 67|}{\sqrt{A + D}}$$

$$= 5.17$$

*t* to be significant at 5 per cent level of confidence has to be 1.98 (N=100).

Our obtained value of *t* is 5.17, therefore, it is significant

*Inference*

Significant change has occurred for this class in regard to attitudes towards science after a school year's class

instruction. (For the case, when N is less than in the value of 20 A+D=10, a correction factor is applied, i.e. A+D-1. The significance of change cannot be

determined from the above formula when A+D is less than 10.

### Elementary Linkage Analysis

Educational intents whether cognitive, affective or even psychomotor in nature, invariably constitute a hierarchical structure<sup>2</sup> This rationale of intents then provides a useful sequence for instruction. Whether the class develops these intents in the proposed sequence or not needs empirical judgement. It seems necessary, in case evidence is contrary for making appropriate measures subsequently. Therefore, McQuitty's elementary linkage analysis has been suggested for the use of the DIET and other teacher educators in collaboration with the school teachers for ensuring quality of learning by the school children.

#### Example

A hypothetical example has been suggested to show how McQuitty's (1957) elementary linkage analysis would be helpful in determining clusters among the sub-components related to either cognitive or non-cognitive domain of learning.

First an inter-correlation matrix has to be created as shown above.

For making clustering of the sub-sets among the reported variables the following steps have been suggested

**Step I:** Underline the highest correlation index ( $r$ ) in each column

	1	2	3	4	5	6	7
Intelligent 1		52	-12	-14	85	-52	18
Sociable 2	52		-58	-60	44	-56	63
Aggressive 3	-12	-58		90	-09	79	-98
Noisy 4	-14	-60	90		-04	70	-95
Verbally Good 5	85	44	-09	-04		-42	15
Clumsy 6	52	-56	79	70	-42		-84
Well-behaved 7	18	63	-98	-95	15	-84	

of the matrix (ignore minus signs).

**Step II.** Locate the highest  $r$  in the entire matrix. The two variables having this correlation constitute the first two variables of cluster number one.

**Step III:** Now identify all those variables which are most like the variables obtained in cluster number one. In order to do this, read along the rows of the variables which resulted in Step II, selecting any of the coefficients which are unidentified in the rows.

**Step IV:** Now identify any variables which are most like the variables elicited in Step III. Repeat this procedure until no further variables are identified.

**Step V.** Exclude all the variables which belong within cluster number

one. Repeat Steps II and IV till all the variables have been accounted for.

On the basis of these steps, the following clusters have been reported.

Cluster I : Bad Behaviour  
Noisy                      Aggressive  
   Unsociable  
   Clumsy

Cluster II : Verbally Good  $\longleftrightarrow$  Intelligent

It is hoped this type of analysis is useful in understanding how cognitive and non-cognitive measures are interrelated and what strategies the teachers had to adopt for their proper development.

#### NOTES AND REFERENCES

- 1 Evaluation neither concerns examinations nor measurement (assessment) but, rather, employs a process of value judgement which helps in making rational and/or empirical decision(s) on matter of education.

In the early seventies, Cronbach, opined that evaluation had to do with making of two decisions. The first one involved deciding the worthwhileness of a programme. The second one ascertained how well the pupils had fared on this programme. In the author's view, then, making of the first decision banks on rational thinking about a course structure. The second decision depends on empirical observations obtained from pupils' learnings related to the imparted course. The paper, therefore, suggests statistical techniques to determine significance of change of students' learnings.

People can be taught to use statistical principles in making judgement (Haberlandt, 1994).

- 2 Interested teacher educators may like to explore the hierarchical nature of their test items related to a school subject, therefore, it is suggested that they utilise McQuitty's hierarchical syndrome analysis technique (Pachaury, 1971).

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# Feasibility of Introduction of Grades in a Public Examination

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## Abstract

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*The use of grades for classification and certification of students performance has been accepted internationally as a better method than numerical marks. This has been advocated time and again in our country. Some of the boards of school education tried to introduce the grading system but could not succeed. There are innumerable reasons for this failure, more non-academic than academic. At this point of time when the National Curriculum for School Education is being revised, there is need to introduce grades in public examinations. Therefore, an attempt has been made to ascertain the feasibility of interpreting actual public examination results in terms of stanine grades. The study reveals that stanine grades can be conveniently employed for certification and classification of students into different ability groups*

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**A**SSessment is an integral part of the teaching-learning process, which has been emphasised in the present as well as in earlier curricula framework. Assessment, besides improving teaching also serves a variety of other purposes such as improvement in curriculum, classroom processes, learning material, educational standards and certification of achievements. The last objective of certification and classification of students' achievement into different classes and divisions has a much wider implication for the present day society. Efforts have been made by state education boards/councils and the NCERT collectively to make this certification and classification as fair as possible. A number of reforms in this direction have been advocated by various committees and commissions appointed by the Government of India but the success does not match the efforts put in. There are many traditional, irrational and unscientific decisions being perpetuated in our examination system from the colonial period. To minimise the inter-examiner and intra-examiner variability in marking answer scripts, introduction of grades have been recommended by the Barrow Committee (1981) and the NCERT National Seminar (1987). As a follow-up of the National Seminar, detailed guidelines (1987) for introduction of the grading system in public examinations conducted by boards at the end of Classes X and XII were worked out. These

guidelines were further discussed in the Conference of Chairpersons of Boards (1990) with the expectation that boards will come forward for implementation. A technical manual (1993) for training board officials was also developed. A study to assess the feasibility was also undertaken.

However, due to lack of will power on the part of boards coupled with the inertia of the existing system, this reform could not take off in spite of the fact that it is beneficial to students, parents, teachers and also to the system. To remove misgivings and to enhance public acceptability, NCERT has brought out a document *Grading in Schools* (2000) which elaborates the use of absolute grades in school based evaluation and nine-point relative grades based on the curve for all public examinations conducted by boards. The present study is an effort to demonstrate the feasibility of nine-point relative grading on a curve to the results of a board examination. The result of Class X, CBSE (1998) annual examination, in five subjects is interpreted in nine letter grades.

### Grading Systems

To overcome our inability of measuring 'human potential' precisely in absolute terms, grades have been considered a better alternative to marks. Numerical marks have lost their psychometric and cultural perspectives. Undue importance is attached to small variation of marks of students in a public examination ignoring the chance factors.

In view of the poor reliability of marking, these marks are questioned for their truthfulness. Therefore, it is better to place all students displaying almost similar performance within a range in a single grade and displaying different performance in different ranges in different grades. The grading can be direct grading or indirect grading. In direct grading, the performance exhibited by the examinees is assessed in qualitative terms using letter grades (A,B,C, etc.). This is mostly used to assess non-scholastic outcomes in the school but can be profitably employed for assessing scholastic outcomes as well. In indirect grading numerical marks awarded to examinees are converted into numerical grades (1,2,3...) or letter grades (A,B,C, etc.). This is also possible in two ways: either in absolute grades or in relative grades. In absolute grading, the range of marks for different grades is pre-determined. As an example all students getting marks between 91-100 will get letter grade A or a numerical grade 10. In the same way, all students getting marks between 81-90 will get grade B or nine. Therefore, in absolute grading, the range of any grade is pre-determined irrespective of the frequency distribution and nature of the subject. school based evaluation in curricular areas can be conveniently reported in terms of absolute grades.

Relative grading, sometimes known as 'grading on a curve', is the process of converting numerical marks into letter

grades (A,B,C etc.) on the basis of almost a fixed number of examinees in each grade. Assuming the distribution of scores of examinees in large public examinations to be normal, it is convenient to pre-determine the percentage of examinees in each grade based on a 5-point scale or 7-point scale or even 9-point scale. The entire range (0-100) is to be accordingly divided into required intervals of equal sizes. Each scale has its own merits and demerits and can be profitably exploited. However, the use of 9-point stanine scale for relative grading is considered most appropriate for classification of pupils' achievement in any examination. These 9-grades (A to I) along with percentages are shown below in the normal distribution

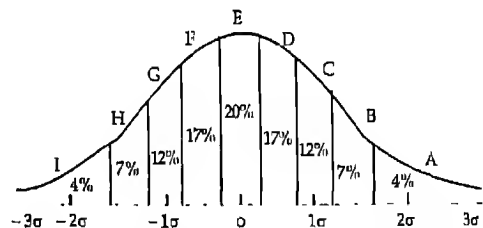


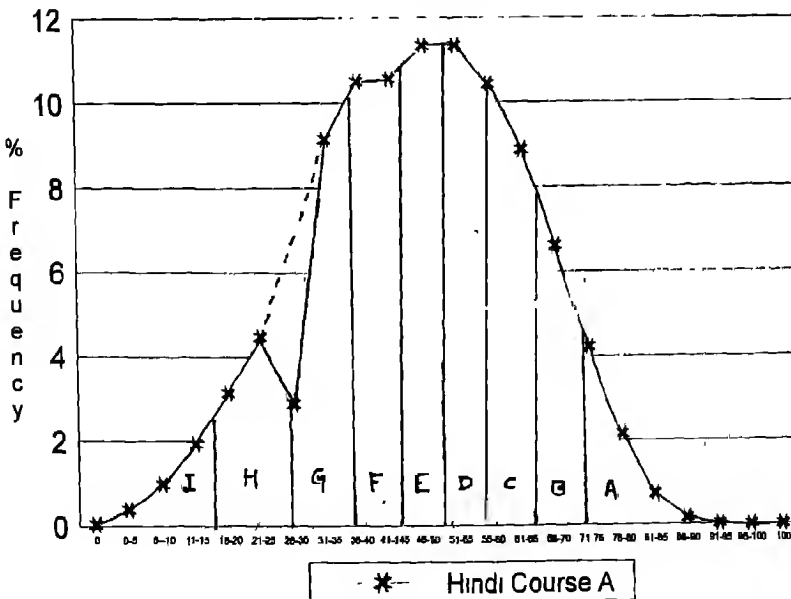
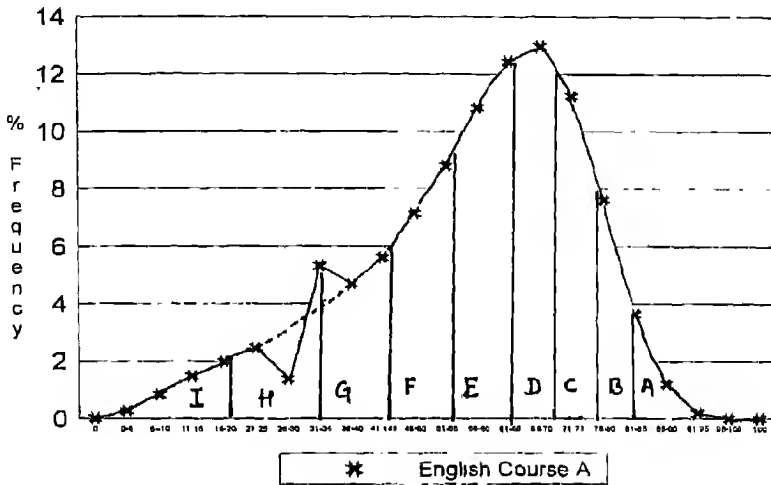
Fig. 1 Stanine grades for normal distribution of scores

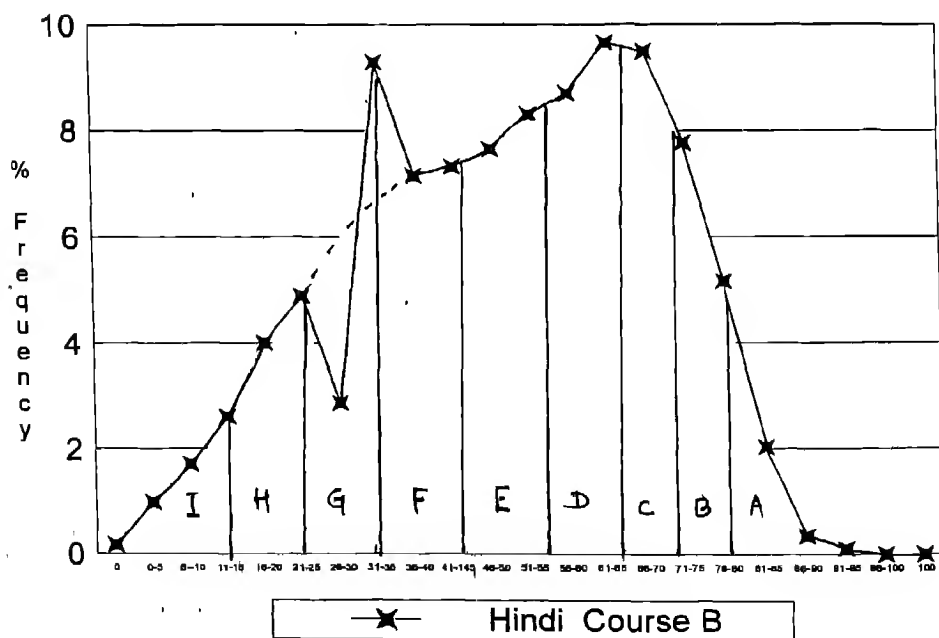
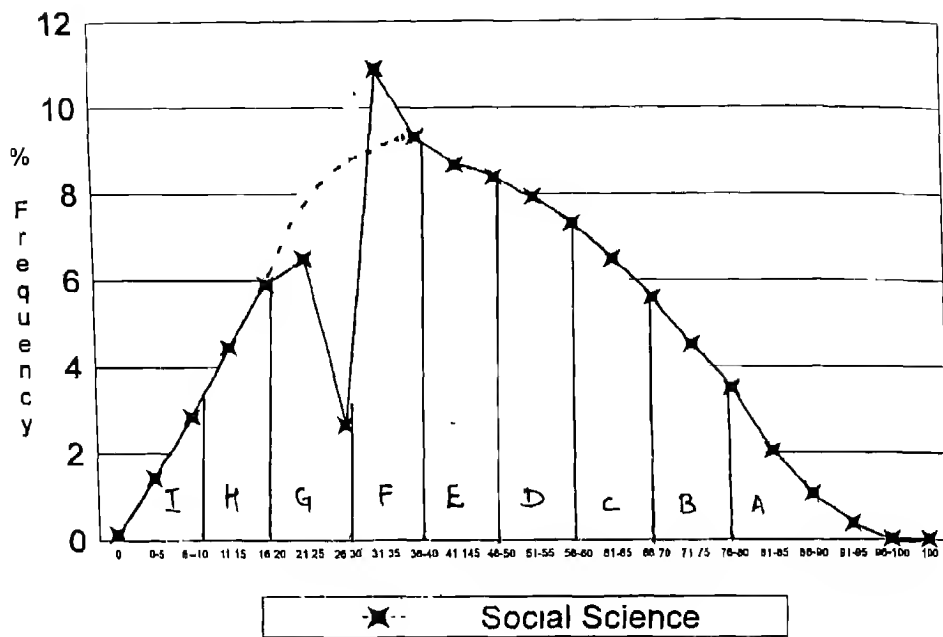
The top four per cent candidates in each subject are expected to be awarded grade A and the next seven per cent grade B and so on. Similarly bottom four per cent and the next higher seven per cent will get grades I and H respectively. Employing stanine grades it is possible to compare the performance of candidates within a subject and across subjects.

### Interpretation of Class X Result in Grades

The result of Class X of CBSE in six subjects i.e. English Course A, Hindi Course A, Hindi Course B, Science, Social Sciences and Mathematics is interpreted. The data is given in Table 1. The

perceived distributions of these subjects are not exactly normal because these are subject specific and depend upon the very nature of the subject. The fixed cut score of 33 per cent for pass/fail gives rise to J-effect (tendency of examiners to pass students getting marks between







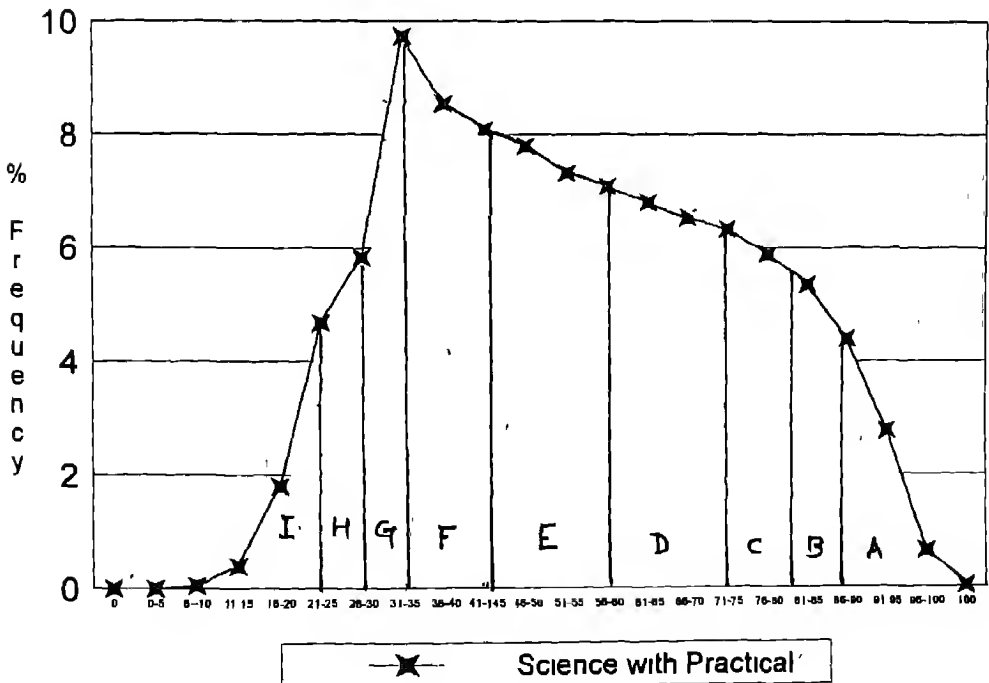
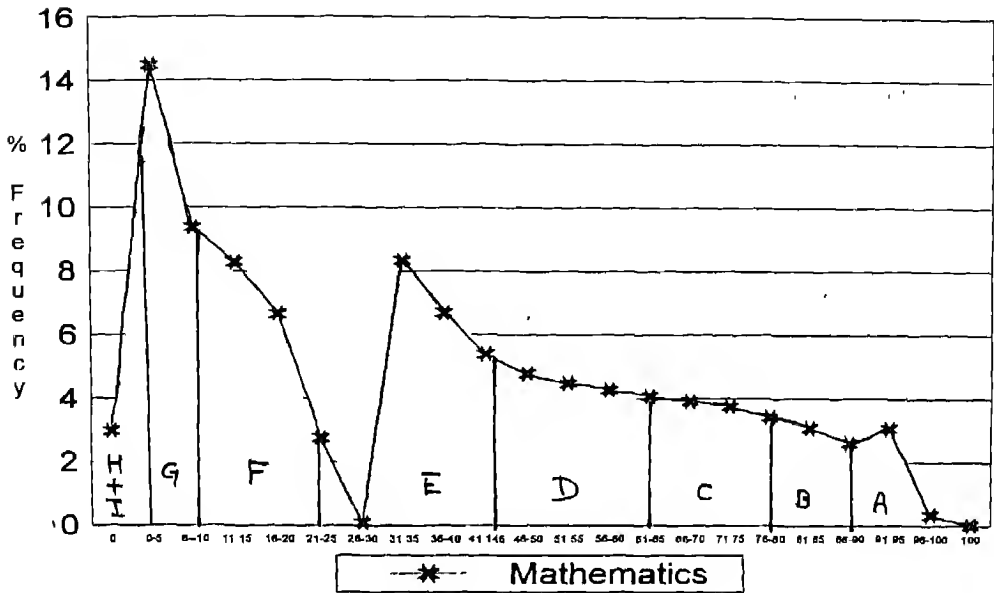


TABLE 1

## Frequency Distribution of Class X CBSE Result(1993) in Different Subjects

Frequency Interval	Per cent Frequency					
	English Course A	Hindi Course A	Mathematics	Science with Practicals	Social Science	Hindi Course B
00	.01	04	2.98	-	14	0.18
0-5	0.27	39	14.49	-	1.44	.98
6-10	0.83	98	9.37	05	2.86	1.71
11-15	1.47	1.94	8.29	0.39	4.45	2.61
16-20	1.99	3.15	60.67	1.80	5.91	4.00
21-25	20.46	4.48	2.76	4.68	6.50	4.88
26-30	1.38	2.89	0.09	5.83	2.66	2.86
31-35	5.31	9.15	8.35	9.73	10.89	9.29
36-40	4.65	10.50	6.70	8.54	9.33	7.16
41-45	5.60	10.57	5.40	8.08	8.68	7.33
46-50	7.13	11.35	4.79	7.80	8.40	7.66
51-55	8.79	11.35	4.79	7.32	7.94	8.31
56-60	10.82	10.44	4.27	7.08	7.32	8.71
61-65	12.42	8.89	4.08	6.80	6.50	9.66
66-70	12.97	6.61	3.92	6.53	5.60	9.50
71-75	11.23	4.22	3.75	6.32	4.52	7.78
76-80	7.61	2.16	3.42	5.88	3.50	5.16
81-85	3.63	0.74	3.07	5.35	2.05	2.03
86-90	1.20	0.17	2.60	4.39	1.06	0.35
91-95	0.18	0.02	3.06	2.77	0.38	0.1
96-100	-	-	0.34	0.65	0.02	-
100	-	-	0.02	0.02	-	-

29-32) in all subjects. The curve can be smoothened as shown by dotted lines if J-effect is not eliminated. The practical marks in science also boosts the performance. The distribution in mathematics is peculiar. The frequency curves of marks of different subjects are given on pages 115, 116 and 117

### Inferences

- (i) *English Course A*: The distribution of marks is negatively skewed. Therefore the range of higher grades i.e. B and C is narrower than that of other grades. The grades I and A are of comparatively wider range.
- (ii) *Hindi Course A*: The distribution of marks is normal. Ignoring J-effect, stanine grades are applicable to the curve.
- (iii) *Mathematics*: The frequency distribution in this subject is quite peculiar. It is rather a combination of two distributions and can be considered as bi-modal distribution. J-effect is predominant. About 15 per cent examinees have scored between 0-5 range. Thus I and H grades fall within this narrow range (0-5). The ranges of other grades are comparable and nearly equal.
- (iv) *Science*: Due to practicals, no student is getting marks between 0-5.

Therefore, lowest grade I is spread over a wide range (6-25). The marks are further clustered around a score of 35 due to J-effect. All other grades are spread almost equally and result can be well represented in grades.

- (v) *Social Science*: The distribution in the case is nearly normal except the pre-dominance of J-effect. The range of all grades is also nearly the same except A grade. Therefore, grades can be employed for certification.
- (vi) *Hindi Course B*: The frequency distribution is nearly normal and results are well interpreted in grades.

It is found that the perceived distributions of marks in different subjects are not similar; rather, these are subject specific. Due to fixed cut off (33 per cent) for pass/fail, J-effect is apparent in distribution of all subjects. If pass/fail is abolished, the effect will vanish and the grading curve will vanish and the grading curve will further smoothen for better interpretation of results. Therefore, it is evident that by transferring the perceived distribution into a normal one, stanine grades can be profitably employed for certification and classification of examinees in any public examination.

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# JOURNAL OF INDIAN EDUCATION

NOVEMBER 2000

*Special Issue on  
Creativity in School Education*



राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्  
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

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The *Journal of Indian Education* is a quarterly periodical published by the National Council of Educational Research and Training, New Delhi.

The purpose is to provide a forum for teachers, teacher-educators, educational administrators and research workers; to encourage original and critical thinking in education through presentation of novel ideas, critical appraisals of contemporary educational problems and views and experiences on improved educational practices. The contents include thought-provoking articles by distinguished educationists, challenging discussions, analysis of educational issues and problems, book reviews and other features.

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# JOURNAL OF INDIAN EDUCATION

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## Special Issue on Creativity in School Education

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## About This Issue

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*Creativity has always been built into every curriculum. It is very often conceived to be the ability to bring something new into existence. It is not a fixed and static quality but something that changes over time. Teachers can develop their own creative powers as well as provide an environment which would nourish and strengthen the creativity of their students. To emphasize the importance of creativity in school education so that the powers of self-expression, spontaneity, courage, flexibility, awareness and willingness to try new methods are developed in teachers and students, the present special issue of the **Journal of Indian Education** is being brought out by the National Council of Educational Research and Training*

*Researches conducted in India and abroad have shown that planned interventions have increased the creativity scores of the subjects. Therefore, the chief goal of this issue of the **Journal of Indian Education** has been to move a step forward in this respect by providing exemplar materials for the use of teachers so that initiation, development, and nurture of creativity are tried by them in their schools*

*Experienced teacher-educators with specialized content background and a deep understanding of pedagogical knowledge have designed activities in this issue for the promotion of creative thinking in different school subjects. I hope school teachers and teacher-educators would use these suggested activities for creative endeavours. Many teachers would like to devise their own activities. This would develop an attitude of experimentation for generating culture-specific materials*

*I would like to thank all the contributors for designing creative thinking activities in their specialized fields for the use of school teachers. Shri A.C. Pachaury, Guest Editor, deserves appreciation for his efforts in getting the manuscript finalized and in editing it.*

J.S. RAJPUT

Director

National Council of Educational  
Research and Training

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# Teaching for Creative Endeavour

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## Abstract

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*This article provides clarification of the concept of creativity: the thought processes, skills, abilities, qualities fundamental to creative endeavour. Based on researches, it further highlights that teaching for creativity aims towards the holistic development of children, improved teaching-learning process, and a better personal and professional growth of teachers. A viewpoint has been put forth that it is possible for teachers to promote creativity while teaching different subject areas. The right kind of teachers' attitudes, behaviours and ways of interacting with children create proper conditions for creative teaching. Some exemplar activities suitable for primary and upper primary stages developed and tried out by the author, illustrating the applications of a few teaching strategies in different subject areas, are presented. Guidelines and indices for evaluating the effects of creative teaching are also given. Suggestions are made to stimulate teachers to take the challenge and continue their efforts towards teaching for creativity, as the benefits are rewarding.*

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**"C**AN we teach children to be creative? Or, are they born creative? Does creativity occur only in special individuals like Edison, Einstein, Mozart, Picasso or is it a normative process and available to every human being?" These are some of the questions asked most frequently by teachers.

In the past, the belief that creativity could not be taught was widespread. The notion about the unchanging nature of creativity raised a great deal of controversy. The current consensus, however, holds that potentials can be fulfilled and maximized.

There is hardly any disagreement on the point that creativity—which is the outcome of abilities, habits, motivation, personality qualities—is the product of both genetics and environment. If creativity were determined by heredity alone, there would be little that teachers could do to nurture it. As in case of other mental and physical characteristics, limits of the creative potential are set by genetics, and the environmental factors stimulate the development of creativity. Realistically, it is therefore true that no amount of creativity training can transform an average person into Leonardo da Vinci, Edison, Marie Curie, Shakespeare or Tagore. Highly creative and gifted individuals are probably born with a special combination of creative potential—extraordinary drive that leads them to

creative performance. At the same time, it is true that every individual can raise his or her level of creative potential beyond its present level. Efforts to enhance creativity thus will not expand one's inborn potentials but can ensure that these potentials are maximized. School is the place where organized efforts can be made by the teachers to develop in students the basic foundations, abilities, skills and attitudes necessary for creative achievement in life. In order to achieve this, there is a need to provide proper environment for creative expression and training for its development in school right from the early stages. This is possible and has been indicated by research evidence.

### **What Creativity Involves and How it Works**

Attempts have been made to understand creativity from different perspectives. Volumes have been written to define what creativity is. There are arguments for and against different approaches. Views and findings on the subject continue to be debatable not only due to the multiplicity of angles from which creativity is viewed but also due to the type and level of creativity in question. Indeed, any of the positions or viewpoints can be defended or disputed depending upon what one chooses to prove or disprove. Researches, in fact, in each of the approaches have taught us a great deal. Irrespective of the

controversies and the unresolved issues, however, there is a considerable body of literature which provides insight into the nature and nurture of creativity and the positive effects of fostering creativity in classroom situations

Creativity, as the term is being used in the present context, involves thinking of ideas in novel ways, branching out from the conventional, adopting alternative ways of thinking, seeing unusual implications and finding new relationships between apparently unrelated things to arrive at original ideas

In creative thinking, a person recognizes the real problem, focuses on different aspects of the problem, is able to become aware of the hidden aspects, open it up or redefine it, identifies sub-problems that are more manageable or can be solved, comes out with alternative solutions and alternative explanations. Researches have shown that the more alternatives a person or group produces, there is greater likelihood of success in solving problems creatively. Thus flexibility in thinking of alternative ideas is important for creative production. Looking for alternatives, however, requires some effort. As soon as a person recognizes a problem, he/she may find immediately that he/she knows what to do. If the person is unable to recall any solution or cannot recall any satisfactory solution, he/she will still be motivated to obtain more

information and make some guesses concerning suitable alternatives. It requires deliberate effort to look for additional alternatives when the person is not satisfied with one or more of the alternatives. A quantity of ideas are generated that would otherwise not be produced/considered. At this stage it is important to avoid the temptation of accepting too easily the alternatives that occur immediately or to avoid premature solutions to the problem and keep one's mind open for creative ideas.

Although production of a large number of ideas increases the chances of original ideas being produced, there is no guarantee that this will occur. Creative thinking and problem solving require a mental leeway from the obvious and habitual way of thinking. Here the motivational factors are especially important in the production of original ideas. The person must be motivated and comfortable with being different to produce original ideas. In order to facilitate originality of ideas, there has to be some 'playing with' the ambiguities, and imaginatively experimenting with various ideas or combination of ideas. At this stage, if adults find something genuine to praise concerning the problem-solving or thinking efforts of students under their direction, this helps in sustaining their efforts. Following this, the problem-solver is led to recognize the weaknesses and deficiencies of his/her solutions or ideas.

Finally, on the basis of these experiences, the problem-solver is encouraged to fill in gaps, redefine the problem, press his/her thinking further or whatever is needed to obtain a creative solution. As children are used to thinking of one correct or best answer only, they are reluctant to think of other possibilities or even build a pool of ideas for later evaluation. Where this situation exists, it is important to make it clear that it is all right to produce such ideas.

Combining and synthesizing ideas results in new connection of elements. This is done by combining something familiar in order to get a new viewpoint on it. This ability or skill is required for production of original ideas.

The ability to visualize objects and concepts also facilitates the process of creative thinking and plays an important role for successful creative work in art, writing, musical composition, creative dance and many other areas of creative achievement. Images which are vivid, away from the obvious, indicate richness of imagery. Fantasy plays an important role in thinking about future possibilities, looking at situations from different points of view and feeling comfortable with the unknown. It allows one to play with possibilities that may one day become realities. Fantasy helps in thinking about the future in a meaningful way and in thinking creatively.

Successful creative problem-solving also requires that alternatives so pro-

duced and chosen be taken up for implementation. There are many accounts of people who invented something or thought of a great idea but did not work out the details of that creative idea. It is not enough to create or invent something, a story, a scientific discovery; it must be elaborated to become of value. A story or an idea can be created in flashes of insight but it takes many hours of writing, rewriting, changing words and sentences here and there to make it communicate 'just right'. It thus further calls for perseverance, commitment and motivation.

From the foregoing, it is clear that expression of creativity depends on the complex interplay of many factors like personal qualities, skills, attitudes and motivations, which are key to the realization of potentialities within everyone. These are essentially related to creativity and are necessary for creative achievement and creative performance in any area of human endeavour. Considering these in a larger perspective, studies of creative behaviour among scientists and writers have shown that these qualities are the characteristics of highly creative people. All of these may not be required in equal measure for creative achievement in all, but the presence of these abilities, skills and attitudes facilitates creation, and their interaction contributes to the emergence of creative thinking and behaviour.

Researches also suggest that it is possible to nurture and enhance these qualities through continued practice and exercise, the same way we strengthen other skills and abilities. For the teacher who is concerned about promoting creativity in the students, an understanding of the various abilities and qualities contributing to creativity should be very helpful. Unless they know what these are, they would not have a very clear goal at which to aim.

### Abilities, Skills, Processes and Qualities Associated with Creativity

- *Fluency*

Generation of many ideas, responses, solutions, questions or suggestions (verbal or non-verbal)

Flow of ideas or thoughts

Number or quantity of relevant responses/ideas.

- *Flexibility*

Generation of a variety of ideas, questions, causes and solutions, as indicated by shifts in approaches or changes in direction of thinking like giving different uses of objects, different interpretations of a picture, story or different possibilities for solving a problem.

- *Originality*

Thinking of unusual, uncommon, novel and off-the-beaten-track ideas, questions, suggestions, solutions, or ways of doing things as a

result of seeing new relationships among ideas, combining remote ideas, stretching beyond the obvious and commonplace, improving things on new lines and looking at the same thing from a new angle

- *Elaboration*

Adding details to the basic idea, a figure or an object and making it fanciful.

Looking into the implications of ideas

- *Sensitivity*

Ability to notice, sense problems, detect missing information and anomalies to spot the uncommon. Sensitivity to feelings, textures, sight, smell and sound.

- *Curiosity*

Inquiring, observing, wondering, exploring, asking questions, toying with ideas, pondering over the mystery of things and objects around, following a particular hunch and then seeing what will happen.

- *Visualization and Imagination*

Visualizing and building lively, vivid, rich and appealing images, wondering about and predicting things that have never happened. Guessing and hypothesizing.

- *Independence*

Thinking or doing things on one's own, independent in making judg-

ments, planning, decision making, figuring out things without any help.

- *Tolerance of Ambiguity*

Tolerating ambiguous, open-ended and messy situations, which puzzle or challenge thinking.

- *Complexity*

Appreciating and tackling different problems and ideas, bringing order out of chaos, enjoying something harder.

- *Risk-taking*

Having the courage to make guesses, not afraid of failures or of trying new and difficult tasks, preferring to take a chance, defending one's own ideas.

- *Improvisation*

Creating resources without much resources or facilities.

- *Openness*

Receptivity to new ideas, resistance to premature conclusions, deferring judgement.

In the light of the term 'creativity', being used in the present context, it is thus more appropriate to ask questions like : Can we teach students to be more original and come up with new ways of looking at things ? Can we teach them to be more sensitive to problems? Can we teach them to see that a problem may have several different interpretations? Even if there is only one right

solution as in Mathematics, can students solve the problems in a number of different ways? Can we teach them to be their own best critic so that they can depend on their own judgment ?" The answer to all of these questions is "Yes".

However, it may be kept in mind that individual differences are there in the abilities and dispositions towards creativity. The extent to which one benefits from or responds to creativity training would differ from individual to individual.

### Goals and Expected Outcomes in Teaching for Creativity

There are many reasons why creative thinking abilities and skills should be developed among children.

- 1 Development of creative thinking is considered important for human survival. It increases the ability of people to cope with the social and scientific changes that the future years will bring. Knowledge alone is not sufficient. Flexibility, originality, creative problem-solving, independent thinking, spirit of enquiry, readiness to try new things, and open-mindedness are becoming and will become even more important. In order to prepare children for the unknown world of tomorrow, to increase their ability to adapt to changes and face the challenges of life creatively, it is important to de-



velop in them the qualities required to become creative.

2. Encouragement of creativity promotes psychological well-being and healthy development of personality. Basic to our democratic philosophy is the recognition that each individual is unique and should be given opportunities for developing his/her abilities and talents to the fullest. Allowing every child to use his/her mind creatively in whatever degree it is possible and in whatever area is pursued, would lead towards self-realization. At the individual level, therefore, helping young children develop their creative potential is a matter of continuing the natural process in their growth and development. This will help promote not only their cognitive development but also affective aspects of personality. When children's creative expression is encouraged and creative abilities are allowed to be developed, their self-esteem, willingness to learn, positive attitudes towards learning and self-confidence are also likely to be improved. If, however, their natural abilities and urges are not channelized to constructive and positive directions, children may become wilful, aggressive and destructive. This may further lead to behavioural problems, emotional disturbances and finally withdrawal from school. Encouragement of creativity thus makes for more effective human development.
  3. At the school level, it is important because teaching for creativity has been shown to make the school learning more effective. At present, students are made to acquire knowledge but do not learn how to process, use and apply the information in creative ways. The development of creative thinking processes, personal and motivational characteristics associated with creativity enhance, among other things, learning to learn. Teaching for creativity gives children opportunities for collecting information on their own, organizing, classifying, making guesses and predicting, testing or verifying. Such learning encounters provide children with wide experiences for being imaginative, playing with discrepancies and questions calling for inquiry, testing their ideas against facts. Rather than soaking facts from the teacher, these processes are found to give zest to learning. Researches have shown that everyone benefits—the talented, the underachiever as well as the slow learner.
- Further, teaching for creativity contributes to enhancing not only the personal development of students but also of teachers and to improving the teaching-learning process.

When teaching for creativity is the goal, students are likely to become more conscious and receptive to creative ideas and innovation. They consciously try to think creatively, and become aware of the importance of creativity in personal development. This process will enhance the abilities and qualities conducive to their overall development.

Further, creative teaching strategies provide creative ways to bring about better learning. Children are motivated to become involved in creative learning experiences. The classroom is likely to become a more enjoyable place for students. Creativity thus would become a vehicle for improving the quality of teaching and learning.

The goal of fostering creativity in teaching would also enhance personal and professional growth of teachers themselves. Teaching strategies conducive for creative thinking would necessitate that teachers have positive attitudes and ways of interaction with children. This would help them practice the skills of creative teaching, which in turn would add to their professional growth as creative teachers.

Overall, the goal of fostering creativity in children is expected to facilitate effective teaching and learning through better learners' and teachers' development along with improved methods of teaching.

### **Some Classroom Principles**

Following are some principles that the teachers in the classroom should value

to provide a responsive climate for teaching creativity. These are related to the teachers' attitudes, behaviour and interaction with children. In the absence of the right kind of attitudes, creative teaching techniques or strategies may not be useful or effective.

### *Providing a Psychologically Safe Environment*

One of basic principles of creative teaching is the development of a classroom environment that is free from excessive competition, threat, ridicule, sarcasm, etc. Interest prevails in this kind of environment. Children feel free to discuss problems openly with the teachers. They are encouraged to express their own ideas and feelings. It is certainly not an environment dominated by an authoritarian teacher, nor is it a wholly permissive or chaotic environment without any structure or discipline. It is an environment that provides a framework within which the child learns. In reality, it aims at creating an emotional climate for students to experience a sense and feeling of personal worth, dignity and self-confidence, ultimately leading to self-discipline. A number of studies reveal that a climate that lowers fearfulness and threat stimulates creative expression.

### *Offering Constructive Criticism*

Criticism is, in fact, a necessary part of teaching, because it is dishonest to al-

low students to feel that what they have done is sufficient even if it is not. In such situations, students may lose confidence in teachers who accept everything and do not encourage students to improve or do better. Many a time criticism implies that a person is completely in error. A gentle way of criticizing is telling a student that the product or idea is not yet worthy of the person's potential ability or performance. Therefore, constructive and meaningful feedback is important. Negative comments need to be avoided. Instead of saying, "You missed that once again; won't you get this right?" you might say, "Can you think of another way of trying this?" Or, "Let me show you another way of doing this".

### *Accepting Mistakes*

Students must be made to understand the value of mistakes. The message is that mistakes are a part of the work and are instructive. Children will not then try to hide mistakes or feel embarrassed by them. Similarly, children experience failure at some point but the way in which it is interpreted can have a significant impact on their creativity and motivation. There are some lessons that can be learnt only by making mistakes.

### *Avoiding Impulsive Judgments and Evaluative Remarks*

Occasionally, pupils can be made to do tasks and assignments without threat

of evaluation. If evaluation has to be done, one way is to involve students in evaluating their own work. To begin with the children may find it difficult, as they are usually depending on the teacher's assessment. This tendency can be changed to some extent. For example, instead of giving his/her own judgment, the teacher can ask, "Do you like what you have done? What do you like best of what you have done? What would you like to change to improve upon it?" This is especially important where there are only a few objective standards of evaluation. In any case, vague and abstract evaluation should be avoided. Sometimes, evaluation and judgment may be postponed when the process of generating creative ideas has been initiated.

### *Responding to Pupils' Ideas and Questions*

The response a teacher makes to the questions and ideas of his/her students is probably more important than the things he/she does to stimulate questions and ideas. It is the teacher and peer response that sustain and increase the student's effort. Perhaps, the most important response a teacher can make to students is to be respectful of their ideas and questions; show that their ideas have value. The key concept here is respect for the questions and ideas of the pupil. In so many ways, we unconsciously show that we do not really re-

spect the creative ideas or productions of others, especially if they are children. Criticism, making fun of child's remarks can hinder the child from expressing himself/herself. It is important that students express themselves, because we cannot know what they are thinking unless we let them express. However, respect for creative ideas and unusual questions requires receptive listening and patience on the part of the teacher.

### *Giving Feedback*

The kind of feedback given is of utmost importance in the process of creative thinking. If students are given negative feedback or they sense disapproval by the teacher, they may be unwilling or may hesitate to look at information from a different point of view. There may be many faults with an idea or product; but if they receive some acceptance through praise, they do not have to set up their defences to ward off criticism and are more willing to examine their ideas in a meaningful manner. To arouse students' curiosity, to create the desire to know and to tickle the imagination, a teacher or facilitator must have their trust. The students should know that it is accepted to go beyond the given possibilities.

When children are in the process of identifying, searching, predicting, elaborating, more often than not, rewarding creative thinking by praise or appreciation is important. Instead of negative comments, it is important to

find at least one element of the idea or product, such as drawing or an idea expressed in a classroom, which can be praised. One teacher, after posing a question, found the class absolutely silent; he/she said, "I really appreciate the time you are taking to think this through. This shows me that you have the ability to concentrate." Even in silence, he/she found a way to appreciate and stimulate children to think. Similarly, students' perceptions about some of the things their teachers did that "made a difference" in the lives of the students, as revealed through different researches, indicate that the mutual appreciation experienced between the teacher and the student really made the difference. One student said, "Even when we would fail, he/she would allow the time and encourage us to work at our pace." Another student stated, "He/she always made us feel comfortable with our creativity and uniqueness." Yet another student said, "Our teacher encouraged participation, asking lots of questions and accepting all answers without humiliating us." In searching for the positive points, the teacher may find that even if the end product is not praiseworthy, he/she can look at the parts and praise the specific ideas.

Reward may take many forms. There are gold stars, awards, privileges and public recognition such as reading the child's work to the whole class, dis-

playing it on the bulletin board, etc. The best rewards are the intangibles : a smile, a nod, a pat on the back, a word of encouragement, a chance to display and present one's own work, allowing children to express and share their own pride in their work. When tangible rewards such as stars, stickers, are used, they should come as a surprise to the children, an extra bonus when they have done an especially good work. Tangible awards should be used in such a way that students do not always come to expect them. Whenever awards are given, these may be given for correct work as well as for creativity. If children come to feel that these rewards are the main reason for doing what they do, their creativity will be undermined. Researches have abundantly shown that when children become focused on reward as their reason for doing something, their intrinsic motivation and creativity gradually decline.

#### *Increasing Intrinsic Motivation*

The most significant way in which teachers can encourage creativity is to support intrinsic motivation, i.e. the motivation to do something for its own sake, the motivation to undertake an activity because it is interesting, enjoyable, satisfying or personally challenging. It comes from within. People are extrinsically motivated when they are doing something in order to reach some goal, e.g. earning money, winning a prize, avoiding punishment, meeting a deadline, fulfilling someone else's order.

Intrinsic motivation flourishes when teachers believe that children should be relatively autonomous, where the approach is to offer guidance and a lot of encouragement for children to come up with their own ideas.

Similarly, the results of other studies show that children given autonomy show higher intrinsic motivation, less tension and better conceptual learning.

#### *Avoiding Conformity Pressures*

Besides the teacher, children can undermine each other's creativity through pressure to conform. The effects of peer pressure are obvious in their styles, preferences, which can lead to slump in creativity. Teachers have to show that creative expression is legitimate, then children will realize that creativity is valued in the classroom.

#### *Instilling Creativity Habits*

Teachers have a number of opportunities to help children learn creative thinking skills by modelling those skills. Let the students hear the teachers thinking as they consider different options for an activity such as looking at problems backward and leading their students through the thought process with them. If students consistently hear the teacher saying, "Let us find a really creative way of doing this, How else can we use this ? Let us come up with as many new ideas as possible," they will gradually adopt the attitude for creative thinking themselves.

### *Giving Choice*

Give children choice wherever possible. For example, a science lesson should provide a number of different objects with which to experiment. An art activity should provide a number of different objects and different kinds of materials. Sometimes children may be allowed to choose their own topics for writing in language class and so on.

These principles are fundamental to creative teaching. They signify an overall teaching philosophy, which must be understood by teachers.

### *Incorporating Creative Thinking Processes into Curriculum: Some Teaching Strategies*

As teachers know about the processes and qualities to be nurtured, and are already aware of the subject matter and basic classroom principles, it would not be difficult for them to apply certain teaching strategies to the specific subject areas.

Researches have identified some of the most important teaching strategies, with an array of inputs to allow children to practise unusual thinking, produce a flow and variety of ideas, venture guesses, make predictions, and attempts to verify these as they fit them to their own reality etc. Such processes can occur while children absorb facts, become sensitive to information or data and learn the subject matter.

It may be kept in mind that all the teaching strategies cannot be applica-

ble equally to different subject areas. Teacher has to judge which topics in a particular subject are more suitable for creative expressions. In general, language, social studies and arts provide greater opportunities for creative thinking compared with science and mathematics at the school stage. Below are given some teaching strategies that are derived from the professional literature.

### **Some Exemplar Activities in Teaching for Creativity**

A set of exemplar activities, as many as 60, were developed by the author, making use of the ideas given in the literature and those suggested by some practitioners (Gulati, 1999). These activities were designed for use by teachers to promote a range of creative thinking processes among children through the teaching of different subject areas at primary and upper primary stages. Some of the activities are more suitable to stimulate flexibility, whereas others are meant to promote originality and still others for greater elaboration of ideas and so on.

Each activity has an attractive title and has been presented in terms of the objective, the subject area in which it can be applied, the school stage at which it is relevant, the procedure, expected outcomes and suggestions for the teacher in the form of notes. Some of the activities that provide examples of the practical applications of certain

teaching strategies related to different subject areas are presented here.

### *Quest for Questions*

*Objective* : To encourage flexible thinking by asking provocative questions

*Subjects* : Language, also applicable to all subjects

*Stage* : Upper primary

*Procedure* : Teacher asks children to think of unusual questions they may like to ask. For example, one child says, "The sky is blue". At that point the teacher realizes that there are children who have no idea of how to ask a question. The lesson continues by pairing children together to ask and exchange questions. Most of the questions begin with "How did" or "How would". Later, the teacher says, "How can we get away from asking 'How' questions and use some other words?" As the students practise question-asking, they are likely to achieve a greater and more flexible thinking skill in asking different kinds of questions. Some thought-provoking questions asked by students are as follows.

- Why do snakes have poison?
- Can we see God?
- Why do people die?
- Who is greater than God?
- How can we say that *Mahabharata* and *Ramayana* are true stories?
- Why does the kangaroo run on two feet though it has four feet?
- What makes the wind?

- How do flowers grow?
- What am I made of?

*Expected Outcomes* : Students will be able to develop the art of asking provocative questions. Asking questions will not only help them develop questioning skills but also raise their curiosity to know more about the question they ask and develop the searching skills.

*Note* : The teacher can apply this activity while teaching any subject area. If confined to a particular subject or topic, the nature of questions asked will depend upon the particular topic or subject concerned.

### *Stop, Look and Punctuate*

*Objective* : To encourage curiosity and flexible thinking by finding out similarities between unrelated things, comparing one thing with another, giving new meaning to ideas.

*Subject* : Language (grammar)

*Stage* : Primary

*Procedure* : The teacher can use this lesson idea while teaching different punctuation marks. To begin with, the teacher asks children to brainstorm and enlist all of the different kinds of traffic signs they could think of. For example.

Stop  
Go  
School crossing  
Slow  
One way

## Teaching Strategies

Observation and sensitivity training	Observing minutely and experiencing sensations
Asking questions and provocative questioning	Framing many different types of questions on a given topic or idea Questioning for knowledge exploration, discovering new knowledge about future, imaginary and hypothetical situations
Searching and experimentation	Searching for what happens in an experimental situation
Discrepancies and gaps	Spotting contradictions, missing links, gaps in knowledge
Evaluating	Checking ideas or guesses against the facts; deciding about possibilities and implications, predicting future problems and situations
Associations and analogies	Building relationships, remote and new associations between objects and ideas Finding similarities between things and situations, comparing one thing to another
Combining and synthesizing	Putting fresh and relevant associations of thought, facts and objects into new configurations, reorganizing and combining objects/ideas into meaningful arrangements
Redefinition	Giving new meaning to objects, ideas, looking at the same thing from different angles
Attribute listing	Thinking of main ideas, dimensions of the problem or object and thinking of improving each attribute
Transformation	Making modification, alterations, suggesting improvements, redesigning
Completing the incomplete	Forming multiple hypotheses and possibilities, completing the incomplete in different ways
Visualization	Illustrating thoughts and feelings, expressing ideas in visual form
Brainstorming *	Generating ideas in a group where criticism or judgment is deferred, quantity of ideas is wanted
Creative writing*	Communicating original and imaginative ideas in writing
Role playing*	Expressing imaginative ideas by playing different roles.

\* Brainstorming, creative writing and role playing are specific techniques, which are discussed in detail in *Education for Creativity. A Resource Book for Teacher-Educators*



Then the teacher asks them to wonder about possible similarities between some of these signs and punctuation marks used in writing. Generally, students will associate the 'Stop' sign with full stop (.), 'Go slow' sign with a comma (,) or apostrophe, a 'Go' sign with capital letter, a 'Zebra crossing' with dash and capital letter etc. Students are encouraged to express their ideas individually in making such associations. In order to reinforce their associations, teacher asks them to draw those traffic signs replacing punctuation marks. She/he then passes around a short story and asks the class to rewrite the story using the traffic signs in place of each punctuation mark

*Expected Outcomes :* Children generally find the punctuation marks very boring and difficult to learn, but through this activity students will be able to learn better and remember how and where to use appropriate punctuation marks and at the same time think creatively.

*Note :* Before doing this activity, the teacher should ensure that children know the various traffic signs and have a clear idea of different punctuation marks. Only then will they be able to associate the two together.

#### *Combine and Expand*

*Objective .* To encourage originality and ability to add and elaborate ideas/situations by guessing and hypothesizing

*Subject .* Language  
*Stage :* Upper primary

*Procedure :* Teacher gives a statement to the students like, "The old man ran quickly". Teacher asks the students to think of all the possibilities of why the old man was running. Where he was going? And what time of the day it was? What would happen to him, and so on. Students can add more information to make the sentence more complex. They can continue in this manner to produce at least one original complex sentence

*Expected Outcomes :* Children would be able to expand, combine and improve their simple sentences into complex ones, including such information as when, where, why and under what conditions ? Such activities would help them guess, wonder, think of implications etc.

*Note :* A non-verbal activity on parallel lines can be done in the lower grade like showing a picture of something happening and children expanding the incident and asking questions to seek answers on how, why, what etc. Teacher can use any picture from the textbook or any sentence from the language lesson

#### *Wrap All the Traps*

*Objective .* To encourage flexible thinking and curiosity by stretching imagination beyond the suggested boundaries

*Subjects .* Science, social studies, language

**Stage :** Upper primary

**Procedure :** The following discussion involves the whole class as the teacher talks about traps. The teacher points out how people get trapped in floods, in fires, by storms, in accidents and in various other ways. Animals get trapped in landslides, in forest ways. When you think about it, there are many different kinds of things in the world that get trapped besides people and animals. For example, water gets trapped in clouds and in pipes. Make a list of all things you can think of that get trapped. Some of the items are : sound, electricity, energy, attitudes, heat, sunshine, smoke, laughter, time, power, information, etc. Some of the kinds of traps are : people, dams, batteries, families, records, tapes, jobs, books etc.

The children are asked to write answers to the following questions: Which of the items in our list would you most like to capture and why? If you manage to trap it, how long do you suppose it will remain the way you want it to be? Why?

Some of the exemplar responses are:  
"I will capture laughter forever because people will like me."

"I will trap information in my brain till examinations at least."

"I will capture old memories for long because I love to be reminded of old days."

**Expected Outcomes :** The activity will help children think beyond, from con-

crete to abstract and illustrate their thoughts and feelings.

**Note .** It can be used both as an individual or group activity, oral or written activity.

*Compare to be Aware*

**Objective :** To stimulate curiosity and the ability to see new relationships by imagining hypothetical situations, comparing one thing to another, and building remote associations.

**Subject :** Science

**Stage :** Upper primary

**Procedure :** While teaching the topics like living and non-living things, animals and plants etc., the teacher poses the kind of questions which bring forth inquiry. She asks

- In what ways are the humming bird and the helicopter alike?
- In what ways are they different?
- Which can go faster?
- What can a helicopter do that a humming bird cannot do?
- Which would you rather be—a humming bird or a helicopter, and why?

Students may give the following type of responses.

- Both fly in the sky
- Both have wings.
- Birds need food, whereas a helicopter needs fuel

- Birds can grow, helicopters cannot grow.
- Birds have nests, helicopters do not
- I would rather be a bird because it is free to move here and there.
- I would like to be a helicopter because it will not die

*Expected Outcomes :* Such questions elicit a variety of responses and evoke a great deal of curiosity about humming birds and helicopters. Besides learning about birds and helicopters, the teacher may find that students become eager and further ask a number of questions to satisfy their curiosity. By arousing children's curiosity and interest, the teaching-learning process becomes joyful.

*Note :* This activity can be used for topics where comparison and similarities between things have to be made. Each of the questions can be posed one by one, building a theme based on the topic rather than in the form of some isolated questions.

The activity could be written or oral, depending upon the available time.

#### *Think of New Combinations*

*Objective :* To evoke curiosity, originality and enable students see new connections among objects in the environment by giving new meaning to the objects and looking at things from different angles.

*Subject :* Language

*Stage :* Primary and upper primary

*Procedure :* Teacher gives examples to the students about different innovations that have occurred as a result of combination of different ideas.

Wheel-chair	Fibre glass-curtains
Pocket-mirror	Washing-machines

Then the teacher encourages students to look around in their environment and suggest new items or objects which could be put together or combined to bring out something new. Some original ideas can be recorded and put on the notice/display board in the class to stimulate others to come out with original combinations.

*Expected Outcomes :* Students would be able to invent new combinations of ideas and objects.

*Note :* The activity may not be done in one class period only. Students can be encouraged to continue thinking to make new combinations or words/ideas and record them.

#### *Feel and Reveal Your Fantasies*

*Objective :* To encourage imagination and curiosity by asking students to imagine a hypothetical situation and express their feelings and ideas.

*Subject :* Social studies, language (composition)

*Stage :* Primary and upper primary

*Procedure :* The teacher asks the students to pretend that they are birds and describe the feelings that they might have. Further, how would they feel as

they viewed the earth from the sky? In what ways would their feelings be similar to the feelings that a human being might experience as he/she observes the earth from an aeroplane? In what ways might they be different? Then the children are allowed to play birds' roles and to experience an empathy with them. Students give response like

- Go around different countries and eat their food without spending money
- Feel free to do whatever they like
- Roads would look like thin lines
- Would have to search for food.

*Expected Outcomes* . Children would be engaged in guessing, visualizing, finding similarities and differences, illustrating, imaginative thinking and feelings—the processes associated with creativity

*Note* : This activity should be applied after some warming up. If children find it difficult to do this activity, teacher may give an example about what she/he would feel as a bird, if she/he were in the air.

Teacher can adapt this activity depending upon the age group. Younger children can do it through role-play whereas older students can express through writing.

*Relate and Innovate*

*Objective* : To encourage fluent and original thinking by forming remote associations

*Subject* : Language

*Stage* Upper primary

*Procedure* . The students have a lesson on analogies, such as 'glove is to hand as shoe is to foot', and 'clothing is to humans as skin is to animals'. They are asked to think of other analogies. These are written on the blackboard. They are given sheets of paper and asked to think of some new analogies that have not been mentioned before. The children come up with some very unusual analogies, such as

- God is to heaven as we are to earth.
- Clock is to time as calendar is to days
- Air is to sky as ground is to earth.
- Numbers are to counting as letters are to reading

*Expected Outcomes* . The activity is likely to inculcate open-ended thinking and imagination beyond the rigid boundaries. This can further help teacher identify children who have the potential for expressing creative ideas through language. They can further be given encouragement for creative writing incorporating rich and unusual analogies.

*Note* . Students must be thoroughly explained the processes involved in thinking of simple analogies before asking them to come out with unusual analogies. These must be explained with examples.

### *Act, React Off the Track*

**Objective** To encourage fluent and original thinking by playing different roles, giving new meaning to the old, visualizing the consequences

**Subject :** Language

**Stage :** Primary

**Procedure** The teacher reads the story, of 'Goldilocks and the Three Bears' to the children. The story is dramatized by the children. After one performance, the teacher says, "Pretend that Goldilocks knocked at the door. She walked in the house just as the three bears came into the kitchen. Think of all the things that would happen." The children suggest : she would run, she would scream, etc. After the teacher discusses the list of ideas the children thought of, she/he says, "Use your imagination and write a new story with a different beginning and ending". Let us pretend that when Goldilocks and the three bears saw each other, they were not afraid. Now make up a new and different ending for this story.

**Expected Outcomes :** Children try to come out from the routine and conventional thinking and apply their imagination to think of off-beat ideas

**Note :** With some variations in the story, the activity can be used for different grades.

### *How Else Could It Be Used ?*

**Objective** To encourage original thinking and ability to improvise materials and objects by thinking of alternative views and redefining

**Subjects :** Language, work experience (SUPW)

**Stage** Upper primary

**Procedure** Teacher talks to the class about the things that are used almost daily, like pen is used for writing, chalk for writing on the blackboard, chair is used for sitting, ping-pong balls for playing etc. Then she/he encourages the students to think of different unusual ways to use any one or all of these such as pen, paper, chalk, chair, ping-pong balls, a broken tea cup, tin can, coconut shells, broomsticks and other throw-away objects. Students can be made to write the unusual uses individually or they can be asked to express orally. When children speak out the uses, the teacher notes down the unusual ones on the blackboard. The activity can be further extended to the SUPW class where children actually try to improvise with some throw-away objects like rubber bands, clips, paper, thread, stones, small pieces of clothes etc. They are then asked to combine these things to make a creative product even if they are unknown at present

**Expected Outcomes** Students would be able to think of various possibilities to

use common objects in unusual ways and also will get hands-on experience

*Note:* Teacher can add a number of common objects from daily life about which children are encouraged to come out with unusual uses

The activities presented in the foregoing have been tried out on students from primary to upper primary grades (Gulati, 1995). Both the test data and teachers' perceptions provided some evidence of the short-term impact of the activities designed to foster creativity in students. The study suggested that effects could be far reaching if such activities are incorporated throughout the school curriculum. The nature of a particular activity can be made more simple or complex depending upon the teacher's initiative and imagination. These may not be taken as prescriptive to be dutifully followed from the beginning to the end. Teachers can modify, supplement and expand according to their own requirements. These serve only as starting points or leads. For that, however, teachers should be well-versed with the thinking processes to be nurtured and the general teaching strategies explained earlier. The activities must be used and integrated with subject areas to be more meaningful. The *ad hoc* or arbitrary use of such activities may simply be enjoyable to students but may not prove to be effective in fostering the attitudes, values and skills required to think creatively.

## Valuation in Creative Teaching

Using these activities as an integral part of teaching will give teachers an overall picture of students' creative potential. These can help teachers discover and spot more creative and not-so-creative children in different areas. Some may be good in creative writing, others in oral skills, some may show the ability to think of original ideas but may lack the ability to go into the details, some may produce a number of ideas but may need more prompting and encouragement to think beyond the obvious unless some examples and cues are provided. Teachers can indeed keep a profile of students on different dimensions, because it is important for the teacher to know whether or not his/her efforts have been worthwhile. Generally, for research purposes, pre- and post-tests are used to assess increment in the level of creative thinking. But for teachers, purpose is less formal. The best tool for the teachers is observation of students. They can devise their own check-lists or rating scales to assess children on different dimensions like the ability to come up with a number of ideas or solutions, ability to come up with a variety of alternatives or different categories of answers in a given situation, ability to come out with rare and unique ideas compared with the ideas of others in the group, ability to add details to the basic idea. A check-list could be devised to observe changes

in students' ways of thinking and expressing emotions and ideas, solving problems, questioning, participation in classroom, keenness and involvement in observing gaps in the environment, willingness to stretch imagination etc.

Students at the upper primary stages can be involved in self-evaluation. Students' participation in assessing their own growth and development is likely to make them feel important, and increase their sense of taking responsibility

### Teacher's Challenge

It is a challenge for teachers to introduce teaching strategies for creativity, because they may think that much valuable time will be lost and the prescribed syllabus may not be completed. Further, creative teaching requires extra effort, flexibility and more time.

Though some of these concerns may be real, these should not dampen the teacher's enthusiasm. This is because the introduction of creativity in the teaching-learning process is simply following the psychological process of learning and, at the same time, providing stimulation, enjoyment and motivation to self-learning. There is evidence to prove that learning through creative expression leads to better retention and recall of material learnt. There is better all-round learning, confidence, feeling of success, joy and satisfaction. If children are learning through creative ways, they become more involved in their work, more tolerant to ideas of others, free in expression, better motivated and curious. That is indeed the biggest reward for the teachers to get motivated and continue their efforts towards teaching for creativity

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# Initiating Creative Thinking in Five-Six-year-old Children

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## Abstract

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*It has been wrongly premised that unless children have developed the skills of reading/writing, not much creative productivity can be developed or nurtured in them through schooling. Therefore, through this paper, the author has examined the possibilities contrary to this notion*

*On the basis of empirical evidences, the author has tried to highlight how activities like play, story telling, just suppose, lexical phrase creation, freeze framing, asking questions, creative arithmetic, sounds, scrap materials, and sensitivity to problems can be exploited by the teachers of school entrants to promote the creative potential of their students. Besides creative learning for teachers, positive creatives of the disadvantaged groups have also been included. Acquaintance with the scoring of the creativity components of fluency, flexibility, originality and elaboration has been also suggested. Brief notes too have been drawn for the benefit of the DIET/teacher-educators at the elementary stage. It is hoped that the suggested activities would help the primary school teachers in initiating creative thinking in 5-6-year-old school entrants*

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**I**t has been argued by the cognitive theorists and constructivists alike that the individual constructs his/her own meanings on the basis of past experiences and level of cognitive negotiability (Pachaury, 1995). Viewed in this perspective, human learning is neither merely acquisition of knowledge, but nor also conservation of structures emphasized by the nativist theorists. Learning rather according to epigenetic system assumes the synthesis of transformation and conservation (Piaget, 1973). This is possible, because the human brain has the capacity to transform and elaborate percepts and concepts (Landa, 1974) by employing hierarchies of classes and relations.

Children normally enter the school around the age of 6+. Research evidence suggests that school entrants would be at an interphase of pre-operational and concrete operational stages of cognitive development (Pachaury, 1996). Hence, it is desirable that the initiation of creative thinking in five-six-year-olds be commensurate with their natural neuropsychological levels of development.

### Rationale

The 'Structure-of-the-intellect' model of Guilford views creativity in terms of divergent production abilities. Divergent production is "the ability to see an event or stimulus from a multitude of perspectives, which is an essential factor in any

creative process" (Ginsberg and Oppen, 1969). How the human mind structures various forms of realities into creative acts has been aptly described by Dirkes (1977).

Construction and invention transform reality into products through cognition, convergent production and divergent production, or through a combination of these operations interposed by evaluation.

Of the 24 divergent production abilities (Guilford, 1956) that lend support for creative functioning, only 10 have been found worth initiating in children (Guilford, 1973). Five such divergent production abilities are related to the semantic domain and the other five to the visual-figural domain.

Jenson (1969, 1972) attributes 80 per cent of variance due to heredity for the development of human intelligence. Individual differences in creativity are almost entirely attributed to life experiences (Torrance et al. 1978). Studies by Tisdall (1962), Rouse (1965) and Cawley and Chase (1967) suggest that even mentally retarded children are capable of thinking creatively. Commenting on the nurture of creativity in school children, Guilford (1959) observed

Our creative powers are developed through the exercise of our divergent thinking abilities and this component of intellect has been grossly neglected in our elementary schools

Torrance and Safter (1986) have voiced almost similar views when they asserted that "teachers are often ill equipped to develop, support, or evaluate creativity in their students". Therefore, nurture of 5-6-year-old children's creative thinking abilities have been emphasized for the creation of human resources not only by the developing countries but by the technologically advanced nations like the United States of America and Canada as well.

### Characteristics of Creativity Fostering Activities

Gulford (1970) observed that "creativity is not any one thing, it is many things and takes many forms". Osborn (1967) asserted that "it is ageless". On the basis of these premises, therefore, the author is of the view that creative thinking can be developed in many different ways. Some activities are suggested below that can foster development of creative potential in 5-6-year-old learners.

Three criteria that have been employed in suggesting activities that would entail development of divergent productive thinking are

- 1 Openness forms the fundamental characteristic of any activity, as children respond to it on the basis of their experiences and cultural background (Torrance, 1970). Such activities provide an opportunity for children in "reaching toward the unknown" (Darrow and Allen, 1963)

- 2 Children spontaneously participate in games like test situations (Jay, 1952; Khatena, 1974; Moran, 1983, Wallach and Kogan, 1956; Ward, 1968).
- 3 Activities that have been empirically validated for 5-6-year-olds (Davis and Rimm, 1977; Khatena, 1974; Moran, 1983, Rakdal, 1977, Rimm, 1976; Rimm and Davis, 1976; wallach and Kogan, 1965; Ward, 1968).

### Suggested Activities

Torrance (1970) observed that divergent productive thinking activities are "sceptible to improvement through educational experiences" (Isaksen et al., 1993; Parnes and Meadow, 1959, 1960; Samson, 1965, Torrance, 1963, 1965) Therefore, for initiating creative thinking in 5-6-year-old children the following activities have been suggested.

#### *Pretended Play Activities*

Children naturally enjoy play/game-like activities. Pretended play activities provide a rich source for fostering the creative potential of 5-6-year-old children. These types of activities nourish various kinds of imagination by employing self-transformations and transformations of objects, people and situations, etc Pretended play involves a dynamic interplay between cognitive and linguistic experiences of children. These together, therefore, foster creative

development. Imaginative plays are important avenues for building oral expressions of 5–6-year-olds as well. Smilansky (1968) especially suggested socio-dramatic play for the disadvantaged children, because it forms one of their creative positives (Torrance, 1970). Primary school teachers, therefore, can exploit pretended/imaginative plays as a rich medium for the development of creative potential of their students.

In the initial phase, let a child behave like an object that is known to the class, say a duck or any other object with which children have sufficient familiarity. For example, a child then enacts a duck behaviour through either a sign and/or by the sound system. The displayed behaviour of the object by the role player has to be decoded orally by the peers. The assumed roles of objects etc. can as well be represented through body movements. Oral expression exhibited by the role player can also be represented in the figural form by the class. For example, quacking of the duck can be represented through a sketch. Body movements/figural representatives of the played roles would not only build 5–6-year-olds' neuro-muscular coordination ability but also provide them a medium for representation of their thought through 'semiotics', which form a necessary precursor for subsequent operative knowing (Pachauri, 1996).

Depending upon the experiences of the children of 5–6 years, the teacher can extend play/imaginative activities

to other parameters like different kinds of animal calls, foot-prints, food-gathering habits/habitats, etc.

Rural children possess rich and varied experiences pertaining to domestic and pet animal behaviours. They also have much better experiences in comparison to their urban peers about wild animals. Therefore, rural teachers are advised to exploit these experiences of their 5–6-year-old children in conducting imaginative/pretended roles of these animals. Another category of imaginative play situations could be local festive occasions, people of the community and their life-styles. Flower scents/fruit tastes etc. enacted through role playing would be much enjoyed by these children. The teacher may prop a student for a specific role playing in his/her ear and then the class conjectures what it could be.

It is opined by the author that the suggested pretended/imaginative play activities would build 5–6-year-olds' 'visualization' by way of creating alternative possibilities on the basis of their limited information (Torrance, 1970). Besides fostering creative thinking in them, pretended/imaginative role playing activities would also nurture their oral expression.

### *Story Telling*

Children love listening to stories. They also like telling their stories to others. Telling of stories by 5–6-year-olds pro-

motes their constructivist behaviour by living through the process of 'storying' (Drake, 1998). Rekdal observed that 5–6-year-olds tell stories that convey quite accurately their imaginations. These stories can be conveniently transcribed for sentence length (fluency), use of adjectives (flexibility), vocabulary (fluency, flexibility and originality), and imaginative ideas, particularly direct analogies (Torrance, 1970; Khatena, 1976).

Three types of stories may be tried out by the teachers :

*Unusual Object Story* . The teacher may provide a prop for telling a story, e.g. 'there was a yellow crow or a green dog' etc. The children are allowed to do free-wheeling in constructing the story. Disadvantaged subjects had been found to hold better linguistic imagery (Torrance, 1970). Shy story tellers may be encouraged by saying, 'what else happened' or picking from the story context, 'what (character) else it did' etc.

*Empathic Story* : Children develop empathy slowly. It deals with imagining oneself in another's position, i.e. enacting other object's roles. Therefore, this type of story telling depends on creating an empathic situation for the role player. Golman's (1996) emotional intelligence corresponds with Gardner's (1997) interpersonal/intrapersonal ways of knowing. Therefore, it becomes imperative for providing opportunities

for 5–6-year-olds to develop this ability (O'Neill, 1996). Empathic stories are a good source for reflecting upon by children to orally express how the story character feels.

Torrance (1970) cites the work of Bruno Munari's 'The Elephant Wish' as a very good example for the development of empathic stories by the children. 'The elephant was tired of being a heavy, big-footed animal'. The children were asked to imagine themselves in the place of the elephant and to tell what they would like to be. Children employed a fold-out technique, what the elephant was thinking. Depending upon the children's experiences and cultural affiliations, such empathic story titles may be created by the teachers. For example, notorious school children had been daily pelting an old frog of the pond. Construct a story to explain how the old frog would have felt being pelted daily by the children.

*Teacher Tells Incomplete Story* . Teacher may tell a short story of 3–4 sentences to be completed by the children. Such stories provide enrichment situations for elaboration ability.

*Just Suppose*

The major emphasis on this type of material is to create a situation in which children generate 'alternative possible consequences' (Torrance, 1970). The format for such happenings is carried through activities as given below.

It may be done by placing a character (animal, bird and/or a person etc) in nebulous conditions, countries, locations etc. For example, what would happen to you if it snowed for a month continuously.

By changing a variable into less-known condition/situation the children are allowed to think of the possible consequences. For example, if man had a big tail like a kangaroo, or if your pet can talk to you etc.

Children should be encouraged to interpret through causes and consequences of behaviour shown in pictures, photographs etc. This material would help children's ability to produce multiple hypotheses about peoples' feelings etc (Torrance, 1970). For example, a newspaper cutting that represents people being chased by a police squad—what might be the causes for the peoples' agitation?

#### *Lexical Phrase Creation*

Nattinger and DeCarrio (1992) found that lexical phrase creation has proved to be highly motivating by developing fluency in the young children. Lexical phrase phenomenon is easily acquired and occurs very frequently. It deals with the creation of the meaning in a 'context'. Cognitive psychologists and constructivists too view development of meanings on the basis of inter/intrapersonal experiences and the level of cognitive functioning. Torrance (1970) also considers making of 'predic-

tions from limited information' as an effective strategy for creative development' ('Creation of contextual meanings'). First high lexical density words, about 3–4, may be given. After some time it is suggested that low density words be used in this kind of activity.

#### *Freeze Framing and Prediction*

In urban affluent schools that are equipped with video facility, the teachers should freeze pictures on the screen and help the 5–6-year-olds to predict causes for: (a) body movements of the characters, (d) facial expressions, and (c) emotional tones etc.

#### *Asking Questions*

Children by temperament are curious, and to match this need they try to equilibrate it by asking questions. In our enthusiasm parents/teachers too prematurely suppress their curiosity. Thus we go on creating and expanding the pool of conformists perennially. Children ask questions for seeking meanings and connect them with earlier experiences (King, 1995). Many primary through secondary school teachers have endorsed 'asking a question as a desirable trait of an ideal pupil' (Pachauri, 1997). Therefore, exploitation of asking a question for the development of creative potential of school children should be accepted as a welcome move. Questions can be raised in a variety of ways: on objects, stories, picture, situations, riddles and on demonstration/experiment. Discrepant events encountered during

class instruction, however, form a spontaneous situation for raising questions by the students. 'Why' questions should be preferred by the teachers rather than just restricting children to 'what' questions. Some examples of questions are given below.

- Why are flowers coloured?
- Why does magnet attract a piece of iron?
- Why does a spider make a web?
- Why do fruits fall from the trees?
- Why is dry grass yellow?
- Why do mosquitoes make noise?

The chief goal of asking a question by the 5-6-year-olds is to help them create multiple hypotheses on the basis of limited information (Torrance, 1970)

#### *Creative Arithmetic*

Pursuance of creative arithmetic by 5-6-year-olds depends on how well they have acquired the skills of addition/subtraction. For example, they may be instructed to create as many sums as possible with the figures 1-5 that give six as a total. Make as many as possible numbers with figures 1-5 that give 10 as a total. This activity may as well be tried with subtraction skill. As per the SOI model (Guilford, 1967), it measures the abilities of divergent semantic relations of the 5-6-year-old children.

#### *Fostering Creativity with Sounds*

Each of us experiences a variety of sounds daily and also tries to imagine

what they could be. Pestalozzi (1894) also emphasized that first instruction should deal with sounds in the form of spoken and sung activities. Teachers can pick up objects, toys etc. that create sounds and then students are allowed to imagine what these sounds could be. The amorphous characteristic of the sound provides a rich background for making imaginative associations. Urban schools may like to buy sounds test developed by Torrance et al (1973).

#### *Scrap Creativity*

Now-a-days, plenty of scrap materials are available in and around urban homes. Rural environment too has very rich natural things like different kinds of soils and stones, leaves, flower and fruits, sticks and roots, and animals' materials etc. Teachers can help children to create and/or make improvements in these natural and man-made materials. According to Guilford and Merrifield (1960) these materials need some kind of transformation that children apply on them in the form of improvement.

Young children of 5-6-years of age while playing spontaneously with these various kinds of scrap materials display deep appreciation for aesthetic sensibility. They also crack jokes and create humour while interacting with these materials. Hence, it is clear that these materials not only nurture children's productive creativity (specially originality) but they also provide opportunities for the development of their

aesthetics and sense of humour (Lieberman, 1965; Torrance, 1960, Torrance et al., 1968).

### *Sensitivity to Problems*

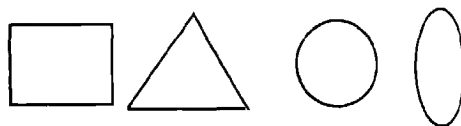
According to Guilford et al. (1951) such task materials assess respondents' ability to see defects/deficiencies etc. during problem situations. For instance, children may be asked to imagine what problems the players would face, if they had to play with a partially deflated football. Other problem situations could be climbing a tree, chasing a wild animal, fetching water from a river, attending to a marriage dinner etc. The teacher is suggested to exploit culture-based experiences of their children. This condition would make them associate remote ideas together. Responses generated by the children can be scored for fluency, flexibility and originality components

### *Fostering Figural Creativity*

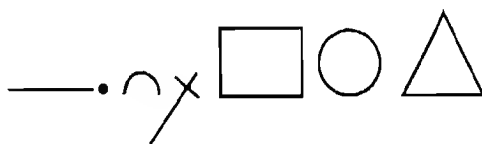
Children enjoy doing figural work. They may be helped to transform their imaginations into figural forms.

**Creation of Object :** Children may utilize crayons, water colours, craft papers, magazine cuttings, straw/match sticks, sand, sawdust and seeds etc. to create unusual objects. They should be requested to tell what they have created. All four components of creativity are nurtured/assessed through these activities.

**Manipulation of Shapes .** Make an unusual object out of the following figures: rectangle, triangle, circle, oval (use each of them independently). Tell what it is. This activity nourishes ability to elaborate objects besides the other three creativity components of fluency, flexibility and originality



**Construction of a Design .** According to Barron (1963), creative individuals manifest tolerance for ambiguity and asymmetry. They also prefer complexity in objects etc. Children should be requested to construct a design by making use of as many as possible of the following shapes

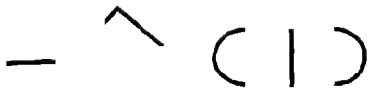


Tell what you have drawn

This activity also fosters stimulation for creative imagination by employing the strategy of synthesis (Khatena, 1975).

**Stroke Exercises .** For nurturing the ability of divergent figural classes (DFC), students should be requested to create as many letters as they can from the following strokes





The teachers can also create  $2 \times 2$  inches ( $5\text{cm} \times 5\text{cm}$ ) squares having horizontal, vertical and diagonal lines, in which a specific word is embedded. The students' task is to locate a word in the square provided. This activity would facilitate development of the ability of divergent figural transformation (DFT) in the students.

#### *Tested Creative Items*

Wallach and Kogan (1965) designed a test battery for exploring creative abilities of children, on the basis of game-like conditions. This test battery was used by Ward and Moran (1983) for assessing divergent productive abilities of the pre-school children. Hence, it has been considered desirable to acquaint the primary school teachers with Wallach and Kogan's test battery, so that on the basis of local experiences and cultural backgrounds of the 5-6-year-olds, the primary school teachers may like to create their own test items.

#### *Verbal Creativity Items*

*Instances* . Name as many things as possible that are round, make noise and are red in colour.

*Alternative Uses* : Name as many ways as possible in which a key, a spoon, newspaper and a stone can be used.

*Similarities* : Name as many ways as possible in which an orange and a lemon, and meat and milk are alike.

#### *Figural Creativity Items*

*Line Meanings* . Name as many meanings as possible for the following drawings :



*Pattern Meanings* . Name as many meanings as possible for the following drawings :



Paramesh has adapted this test battery for Indian subjects in our country.

#### *Scoring Scheme for Creativity Components*

Research evidence suggests that divergent thinking fosters independent learning, invention and transfer in the learners (Dirkes, 1977). "Fluency, flexibility and originality are considered as important divergent production abilities, which contribute to the more complex construction of creativity" (Guilford, 1967). Torrance (1962) operationally defined creativity as including fluency, flexibility, originality and elaboration. Callahan and Renzulli (1977) also con-

cur with Torrance's conceptualization. Hence, looking to the commonality of the creativity components, Guilford, (1977), Mackinnon (1978) and Torrance (1979) have rightly opined that "the phenomenon of creativity was nothing but unidimensional". Zegas (1976) has commented specifically on the similarity of creativity test. Guilford's divergent thinking battery is similar to both the Wallach-Kogan and Torrance tests. Emerging research and statistical methodologies have enhanced our concepts about its multifaced nature. In order to assess the creativity components properly, it would not be of context to first have a conceptual clarity about them. Riston and Smith (1975) have defined them in the following manner.

*Fluency* : It is the ability of the individual who "expresses in a constant stream of communication" (total number of the responses made regarding a stimulus object).

*Flexibility* . It is the ability "to jump readily from one idea to another" (creation of categories of responses)

*Originality* : It is related to statistically infrequent responses made regarding a stimulus object.

*Elaboration* : It is related "to embellish or expand an idea"

Creative thinking tests occur in two formats, i.e. verbal and figural

For fluency, flexibility and elaboration categories, a score of one is assigned

to each response. For originality, a response occurring more than 15 per cent is assigned a score of zero to seven, 15 per cent is given 1 score, 3 to 6 per cent a score of two, 1 to 2 per cent a score of three, and less than 1 per cent a score of four (Cropley, 1967). Udwin (1983) has suggested the following scheme. A response occurring once only is given a score of three, twice only a score of two, and thrice only a score of one.

It has been found that flexibility and originality measures have been confounded by fluency scores (Clark and Mirels, 1970; Johns and Morse, 1997). Therefore, it has been suggested that ratio scores be derived for them, i.e. flexibility divided by fluency, similarity, originality divided by fluency. It is not necessary that the primary teachers be interested in the sophisticated quantification; therefore they might prefer using qualitative assessment for these creative thinking abilities of their students. A three-point rating scale might do the good job, for instance the creativity components have been excellently developed, normally developed or poorly developed. What is more important then is to maintain a profile for each child on the basis of activities conducted for fostering the creative thinking abilities. Wallach and Kogan's test battery is scored for number and uniqueness generated by the subjects. Number is related to the total of responses generated about

a stimulus object. Uniqueness is scored in terms of a response that occurs only once in the set of data. Qualitatively uniqueness is as well marked as moderately, good or very good.

For criterion-referenced measures of Torrance Test of Creative Thinking (TTCT), Ball and Torrance (1980) have suggested that a criterion behaviour occurring once/twice be marked +, and that occurring more than three times to be marked ++.

Researchers had been converting raw scores into standard scores before arriving at either verbal or figural index of creativity.

### *Characteristics of Creative Learning Environment*

Starko (1995) views learning as "a creative process that involves students making information relevant by linking prior knowledge and new knowledge". This necessarily calls for examining the learning characteristics that would promote development of divergent thinking abilities in students. Research has shown that learning situations that encourage "independence, risk-taking and intrinsic motivation" are most conducive for creative thinking in learners (Anderson et al, 1970, Hill and Amabile, 1993; Richardson, 1983; Shaughnessy, 1991). In terms of teacher-student relationship, Torrance and Mayer (1970) have advocated responsive classroom environment. According to them, when the

classroom interactions take the form of respect for unusual questions, imaginative and unusual ideas, and when the students are convinced that they are free from the threat of evaluation, creative thinking flourishes unhampered.

Torrance (1970) suggests that the following six creative positives of disadvantaged children be employed for successful fostering of creative abilities in them.

1. They are high on non-verbal fluency and originality.
2. They work well in small groups.
3. They are exceptionally good in visual art activities.
4. They display high creativity in movement, dance, and other physical activities.
5. They show high motivation in games, music, sports, humour and concrete objects.
6. They have language rich in imagery.

The author feels the need for nurturing creative potential right from the first year of schooling, simply because every child is creative in her/his ways. This human capital has infinite ramifications compared with our limited natural resources. Let us then raise "the general level of creative performance" (Guilford, 1967) of our students for their better tomorrow and a prosperous India.

## Notes

Creativity has been defined in a number of ways. Below are given some definitions of creativity.

- It is the ability to visualize, to foresee, and to generate ideas. (Osborn, 1967)
- It is a normally distributed trait, an aptitude trait, an intrapsychic process and a style of life. (Golann, 1963)
- Creativity is related to creating something new into existence (Barron, 1965)
- Creativity requires leap from the known to alternatives (Pickard, 1990).
- It is the process of sensing gaps or missing elements, forming hypotheses, communicating the results, and possibly modifying and retesting these hypotheses (Torrance, 1965)

Of the 24 divergent production tests, 23 have been found on the basis of factor analyses that promote development of creative potential. Ten such tests (five each for the semantic and the visual-figural) have been found useful

for children (Guilford and Christensen, 1973) These are given below

## Semantic Tests

1. Suggesting plot titles of the stories (DMU and DMT)
2. Giving alternative uses of objects (DMC)
3. Providing alternative words that mean the same (DMR)
4. Writing of sentences on the basis given words (DMS)
5. Suggesting possible goals of people (DMI)

## Visual-Figural Tests

6. Making of things out of sketches etc. (DFU)
7. Making of letters from given strokes (DFC)
8. Making of objects from given lines (DMS)
9. Locating hidden letters in the figures (DFT)
10. Decoration of objects (DFI)

D = divergent production ability, M = semantic; F = figural, U = units, C = classes, R = relations, S = systems, T = transformations; I = implications

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# Creativity in Geography

## Scope and Activities

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### Abstract

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*Creativity is a multi-dimensional attribute distributed differently among individuals. Geography as a field of learning is highly creative, partly because of its nature of content and methods of study and partly because the practitioners of geography have come from various other disciplines. Creativity is the product of cognitive maps. There are several examples of creativity in geography. Guilford and Torrance tests of creative thinking highlight fluency, flexibility, originality and elaboration as creative abilities. Development of these abilities through exercises and activities can lead to the evolvement of creative geography learners. The present paper describes the scope of creativity and some activities for the development of creative thinking in geography.*

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**S**INCE the origin of man, the world has made tremendous progress in the field of science, technology and culture. The world at the time of the Indus Valley Civilization was different from the world of today. Whether the earlier world was better or the present world, may be a matter of dispute, but this is certain that the world has changed. Who has changed the world—man, prosperity or the environment? Prosperity is the product of man. Environment in the pure form is the creation of nature, and in the modified form it is the product of interaction of man with the environment. Man is a creative being. He has created society, villages, towns and cities and has developed agriculture, industries, means of transport and communication, and various forms of arts. All these have given him the new world.

Some part of his creative behaviour is present right from his childhood, whereas some has been nurtured by parents, society and the environment. According to psychologists, "creativity is a multi-dimensional attribute, distributed differently among individuals, and it includes chiefly the abilities of fluency, flexibility, originality and elaboration." Creativity has been studied from time to time under different heads like imagination, intuition, inventiveness, discovery, far-sightedness, giftedness and originality (Gupta, 1980). Creativity is an action of the mind that produces a new idea or insight (Wilson, 1951). It involves the

re-arrangement of past experiences, with some changes, into new patterns to satisfy some expressed need. Creativity is a product of thinking, it requires a process of thinking, it involves a person and needs an environment in which something is created (Tripathi, 1995). Every creative process has a background of its own and is directly or indirectly associated with imagination or originality, consciously or unconsciously supported by imitation (Chakravarty, 1994).

### **Nature of Geography**

Geography as a field of learning is related to significance of location and the spatial relations of things and events. It is fundamentally a holistic discipline in that it studies things and events in their total context. A geographer is a person who asks questions about the significance of location, distance, direction, spread and spatial succession. He deals with the problems of accessibility, innovation diffusion, density and other derivatives of relative location (Dixit, 1994). There are at least five different kinds of questions that are investigated in geographic studies. These are generic questions, genetic questions, theoretical questions, remedial questions, and methodological questions (James, 1972). Geographic writing is addressed to several kinds of audiences. It is popular and descriptive, or highly theoretical, it is practical and directly applicable to current problems of the sort commonly handled

also by engineers, economists, public administrators or businessmen. Whatever be its tone, geography is concerned chiefly with the characteristics of people and places and with the significance of likeness and differences among them on the face of the earth (James, 1954).

Geography follows an approach of study, called geographical approach, which lays emphasis on *location* — site, situation, place, and locality; *spatial distribution* — continuity, discreteness, contingency, pattern, and density; *spatial association* — integration, interdependence, coherence, ensemble, coincidence and complementarity; *spatial interaction* — accessibility, linkage and flows; and *spatial systems* — connectivity, order and hierarchy (Chapman, 1967). Whatever be the perspectives of study — theoretical, behavioural, historical, ecological or regional — the above mentioned conceptual elements are reflected in some form or the other in a geographic writing. A geographer must devote considerable time to reading, re-reading, thinking, re-thinking, writing and re-writing if he/she likes to understand properly the 'cognitive map' that is formed in the mind of a person before he/she behaves or acts in the existing world.

Geography studies a variety of phenomena, physical as well as sociopolitical, natural as well as man-made. It looks at the world from various angles. Owing to such a nature of geography, different workers approach the subject

matter in different ways and yet all of them have something in common which makes them geographers and different from workers in any other discipline (Minshull, 1970).

### Scope of Creativity in Geography

Geography has a vast area of work, beginning from location of the earth in space, land forms, drainage, climate, vegetation, soil, mineral, agriculture, industries, settlements, means of transport and communication, society and politics to development, welfare and planning. It follows an approach of study already described as location, spatial distribution, spatial association, spatial interaction and spatial system. Various workers studying geography have varied background, ranging from physical and biological sciences to social and space-related sciences. All view the world from different angles. With the development of science and technology, movement and processing of the information have become fast and easily available. It is now possible to view a thing in different stages, transmit the information in different forms, and express human cognitions and feelings in different ways. These have increased the scope of creativity in geography. The geography of today is no longer monotonous, boring and dry as it used to be some 50 years back, due to the fast-growing field of information technology, which has made it lively and interesting. It is, however, a pity that

it has not been used to make the subject simple, communicable and creative for the pupils

Geography is a creative science partly because of its nature of content and methods of study and partly because the practitioners of geography have come from various disciplines. There are several examples of creative representations in this discipline. The schematic representation of the modern discipline of geography and its cognate fields is a beautiful piece of creativity. It is expressed in different ways. The schematic representation of the specialized sub-fields of physical geography is no less an effective example (de Blij and Muller, 1993). The march of the seasons as viewed from a position in the solar system is drawn in a variety of ways by different geographers. Therefore, students

should also be allowed to represent their imaginations in different ways. How a particular thing is viewed and how it appears gives beauty to the viewer. If distributions are viewed through graticules/nets of circular lines and/or squared lines, the same appears differently. Figure 1 describes cognized boundaries of a city (Downs and Stea, 1977). The pupils should also be encouraged to create their own images about these objects.

Figure 2 shows the original gerrymander depicted in the *Boston Gazette* of 26 March 1812. The name refers to a senatorial district designed to concentrate Federalist votes. It was at first likened to a salamander but later became known as 'gerrymander', after Governor Elbridge Gerry, who signed the districting law (Kolars and Nystuen, 1974).

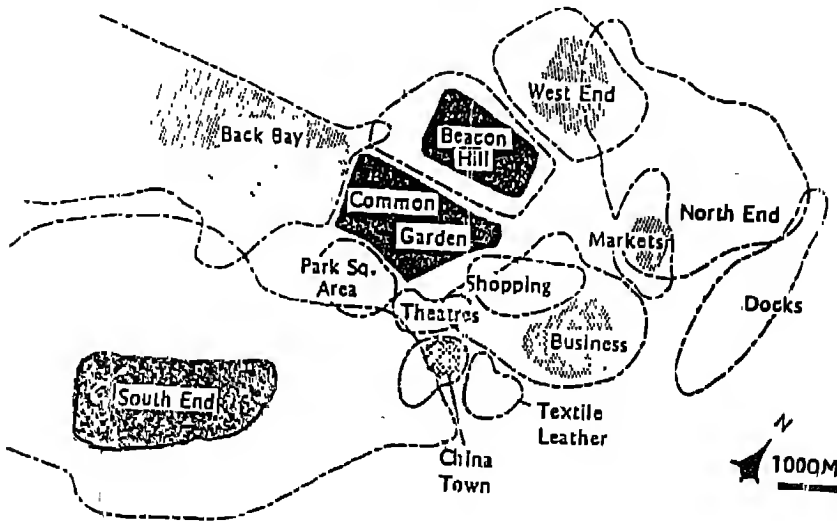


Fig. 1 Cognized boundaries of a city



Fig. 2 The geirymander

The students would be exposed to the geirymander. After some time they would be provided with an outline map of their state. They will be asked to create different representations out of it. This type of activity provides an environment to conceive fixed geographic spaces into transformed spatial situations.

### Mental Maps and Creativity

A *mental map* (or a *cognitive map*) is a product — a person's organized representation of some part of the spatial environment. Cognitive mapping is an abstraction concerning those cognitive or mental images that enable us to collect, organize, store, recall and manipulate information about the spatial environment (Downs and Stea, 1977). Examples

of cognitive maps include a sketch map showing the route to your house, a list of places of a city that you avoid because they are dangerous, a child's painting of his/her house and neighbourhood, and the pictures that comes to your mind every time you try to cross the lanes.

Cognitive maps and mapping vary according to a person's perspective on the world. Cognitive maps are not necessarily visual pictures of the world. Perspectives undergo major changes with increasing age. Both, the ability to map cognitively and the outcome of the process, show qualitative developmental changes since birth. To understand the development of cognitive mapping, we must try to see the world through the eyes of a young cognizer. In addition to age and experience, our perspectives on the world are coloured by the social group, region and nation that we identify with. All variations in perspective which emphasize that 'the world is what we make it, the world we believe it to be' depends upon our sensory capacities, our age, our experience and our attitudes and biases (Downs and Stea, 1977).

Education in general and geography in particular shape our cognitive maps. Geography in schools and colleges changes the form and content of cognitive maps and the operation of cognitive mapping. The teachers believe that they are training the children to understand the world around them, but the cognitive maps are largely untaught. The process of learning to understand one's

physical world begins before formal schooling. Children play games spontaneously and begin to perceive the world from their perspectives. We must construct exercises that are in tune with the level of cognitive competence of the school-going children. The world at present is made of land masses and ocean basins. There are mountains, plateaux and plains. If there were only continents, how would the world have appeared? Similarly, if there were only plains, what would have happened to the rivers?

Spatial problems require us to make decisions about where to get things and how to reach such places. Each decision that solves a spatial problem results in a pattern of spatial behaviour. Since we cannot avoid spatial problems in our everyday lives, we must solve them. Our survival and happiness depend upon finding an appropriate solution. Therefore, we must develop ways of problem solving in children that are reliable and useful for them. There are a large number of problems that need immediate solution on the part of the social being. Thus, creativity provides us with such a facility to cope up with daily living problems in different ways.

### Encouraging Creativity

Guilford in his Model of Intellect found 120 aspects of intellectual functioning, although we do not have tests to measure all of them (Khatena, 1978). According to him, people may use their intellect in a number of different ways to

process raw materials of information. This involves knowing or understanding of items of information (cognition), storing and fixing of information in the brain (memory), retrieving information from storage in the brain to help find a single answer to a problem (convergent thinking) or many possible answers to a problem (divergent thinking), and then comparing and judging the worth or value of the information received or produced (evaluation). The second aspect of his intellect model deals with four kinds of information (content) handled by five mental operations, namely, *figural* (things, images or mental pictures), *symbolic* (information in the form of signs or letters), *semantic* (information that is meaningful and may appear as pictures or words), and *behavioural* (non-verbal information involving attitudes, needs, desires, moods or intentions). The third aspect of the model deals with the different forms or products that information may take when a person processes it. These are *units* (chairs, oranges, child), *classes* (fruits, furniture, numbers), *relation* (a meaningful connection between two things), *systems* (organized sets of units of information), *transformation* (changes in information or in its functioning, and involve revision or modification), and *implication* (something expected, anticipated or predicted from known information).

The three faces of the intellect model described above clearly show the wide

scope of creativity in the teaching and learning of geography and in encouraging children in the process of decision making. Guilford and Torrance Tests of creative thinking highlight fluency, flexibility, originality and elaboration as creative abilities. Development of these abilities through exercises and activities can lead to the evolvement of creative geography learning

### Activities for Developing Creative Thinking in Geography

Man is the most intelligent and creative creature of the earth. He learns by selecting previous experiences and associations, and tries them out in novel situations. Thinking is sometimes distinguished into *ugly thinking* and *productive thinking*; the first is based on trial-and-error and the second is based on cognitive reorganizations (Massialas and Zevin, 1967) According to Piaget (1950) thinking takes place in stages, which are generally determined by the age of the child. In the first two years of age, the child performs only the motor actions (the period of *sensory-motor intelligence*). From two to four years age of the child reasons from particular to particular (transductive) rather than from particular to general (induction) or from general to particular (deduction)—the period of *preconceptual thought*. During the third stage from four to seven years of age the child is "not yet freed from

perception" (the *intuitive period*). The period between seven and 11 years is characterized by logical processes, which are associated with concrete objects or their representations (the period of *concrete operation*). In the final stage from 11 to 15 years, the child attains intellectual capability from deductive and inductive reasoning (the period of *formal operations*)

Creative thinking in geography may be developed from three to five years of age. In the stages of two and three years, creativity may only be observed in actions, activities, looks and behaviour. Keeping in view the nature of discipline and the questions it asks, the following activities are suggested for encouraging creative thinking in geography.

#### Activities for Children of Four to Seven Years

**A Simple Globe :** The children may be encouraged to spin the globe the way they do it. Why does the globe spin only in the way it does? They may also be asked to view the globe from side, top and oblique positions. If you look at the globe from the three positions, what shape will it have? Name different things from your environment that would look like the shape you have suggested.

**A Map Showing Land and Water** The children may be asked to identify the land and water bodies, count their number and describe their shapes. If there were

two big water bodies, what would have happened to land sights? If there were only two land masses, how would they have appeared?

*A Map Showing Rivers, Mountains and Roads* : The children may be asked to identify the features, draw them on a separate piece of paper and paint them. If the rivers and mountains change their locations, what would happen to the area? If the rivers start flowing from the sea to the mountains, what geographical changes would take place? How are a river and a road alike?

*A Neighbourhood Map* : The map may have the following details: roads, buildings, homes of a few boys, school, a post office and a health centre. The children may be asked to read the details. They may be asked to describe the path from home to the school. What difficulties would you face if you are asked to go to school from your house by an unknown route?

#### *Activities for Children of Seven to Eleven Years*

*Globe* : The children may be asked to observe a simple globe showing lines of latitudes, lines of longitudes, continents and oceans. They may be asked to look at the globe from different angles, and describe the shapes of the lines of latitude and longitude. If the lines of latitude had been drawn from north to south and the lines of longitude from

west to east, what problems would the world have faced? What problems or benefits would the people have as a result of these changes?

*Identifying Details in a Map* : The children have been given a map of India showing relief features, rivers, roads, railways and major cities. They may be asked to describe the physical and the cultural features. Why do most of the rivers flow into the Bay of Bengal? If the Ganga plain becomes a sea, what will be the pattern of rivers in India? If the capital of India is shifted to Hyderabad, what changes will occur in the pattern of railways?

*Role Playing* : The children are fond of playing roles of father, mother, teacher, leader and others. They may be encouraged to play the role of persons living in the equatorial, savanna or tundra climate, or the role of a mayor. If a person of the equatorial climate visits the tundra climate, name the things that he/she would be required to carry with him/her. If Sudan starts getting rainfall throughout the year, what changes would result in the natural vegetation? If you are made the mayor of your city, what would you do to solve the problem of drinking water?

#### *Activities for Children of Eleven to Fifteen Years*

*March of Seasons* : The earth revolves round the sun. To show different sea-



sons on the earth, diagrams of various types are prepared and used. There are a variety of diagrams to show the march of seasons, and each shows the inclination of the earth's axis differently. Identify the correct ones, giving reasons. If the inclination of the earth's axis became  $90^\circ$  from the plane of ecliptic, what would its effect be on the march of seasons? If the earth stopped revolving round the sun, what would happen to the seasons on the earth?

*Cognized Boundaries* : The children may be given maps of school campus, neighbourhood or some known towns. They may be asked to draw cognized boundaries of the school campus or the town. If the library is shifted from the present location to the Principal's office and vice versa, describe the advantages and disadvantages that the children would face? A seminar may be organized on the effect of this change.

*Suggesting Ideal Locations* : The children may be given a sketch of a locality of a city showing residential areas, market places, roads and land forms. The children may be asked to suggest suitable locations for a primary school and a health centre. If these are to be established in the locality, what factors would you take into account? There is a map of Chhattisgarh showing raw materials like coal, iron ore, manganese ore, railway line and rivers. If a steel plant is to

be located in Chhattisgarh, what factors would you take into account and why?

*Establishing Relationships* : Activities may be developed to think about relationship between geography and human settlements, and climate and human need. Bhilai steel plant in Madhya Pradesh has given birth to a number of ancillary industries in the area. Suppose an earthquake has completely destroyed the steel plant, how can the left-over resources be utilized? North-western Rajasthan gets water from Punjab through a canal system. Suppose this region starts getting adequate rainfall, how can this canal be used for the development of the region?

The above-mentioned list of activities is only suggestive for the development of creative thinking in the children. In order to encourage creativity, the teacher is required to perform the following roles.

He/she should

- Plan the topics and ideas carefully, covering a period of time
- Introduce the initial material as a springboard for inquiry and discussion, which should provide a stimulating situation.
- Throw challenges and continuously initiate the students to explore and test new alternatives
- Legitimize creative expression. Original work should be rewarded and displayed for the students and the public.

- Perform managerial tasks such as recognizing students and providing them appropriate work.
- Function as a fellow enquirer who has no final and absolute answers to the problems.
- Operate under the assumption that values are not taught, but critically examined.
- Present a permissive atmosphere in the class.
- Believe that originality and creative work need time for contemplation and incubation
- Mark the distinction between specific facts and skills, and general facts and skills.
- Encourage self-initiated learning and promote hobbies.
- Use computer-assisted teaching-learning technology, particularly for

understanding of events in stages or sequences

### Conclusion

The purpose of teaching geography is to guide and direct the development of the following aptitudes. power of observation, memory and imagination, judgment and reasoning, and inculcation of a geographical outlook (UNESCO, 1965). In all of them the component of creativity has a role to play. The various creative activities suggested above would also help children develop *absolute values* like economic, social, ecological and spatial, and *relative values* like analysis of data, explanation of phenomena, understanding of environment, discovery of man's powerful creative ability, respect for different civilizations and understanding of the interdependence of nations (Pinchemel, 1982).

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# Promotion of Creativity through Subject-related Creative Activities

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## Abstract

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*Primary-level children display creativity in their behaviour. However, it diminishes gradually due to rigidity in our educational process and lack of encouragement of the teachers. In this study, promotion of fluency and flexibility abilities were tried through Oriya, mathematics and environmental studies (science) experiences in rural fourth grade students. All these subject-based creative experiences are presented in game-like situations. It has been found that the sampled fourth grade students showed improvement in fluency and flexibility in the selected subjects.*

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**T**HE primary school children have an urge to manipulate objects and raise questions on them. Therefore, they are naturally engaged in the processes associated with creativity. The creative processes that are generally used by them include probing, discovering, imagining, fantasizing, and attempting to communicate in new and different ways. These creative behaviours diminish gradually with increasing pressure and demands for uniformity, conformity and standardization imposed by the schools. Schools do not permit them to ask unusual questions, try new approaches to problem-solving, to play with ideas and materials, and use divergent ways of dealing with traditional topics. Researches are testimony to the fact that those who had creative potential in the earlier years of schooling lost much of it as they proceeded through school years (Goodale, 1970).

It is true that some children with vigorous imagination can maintain their creativity in spite of their rejection and disapproval, but many fail to manifest their creativity at an optimum level. Neglect of their creative abilities may result in loss of interest in learning, in causing behavioural and emotional disturbances and subsequent withdrawal from school. It is, therefore, pleaded to recognize and energize creativity right from the early stages of schooling.

### **Rationale**

A creative person is the product of a number of abilities and favourable per-

sonality traits. Divergent thinking encompasses creative functioning according to Guilford's Structure-of-Intellect Model (1950). He considers divergent thinking as productive operations. Divergent production deals with producing new combinations. In actual practice, both the terms 'thinking' and 'production' are synonymously used as creative thinking (Guilford, 1959; Torrance, 1962). Divergent thinking implies thinking in different directions.

Divergent thinking abilities include fluency, flexibility, originality and elaboration. Fluency is the ability to produce many ideas for a given task. The more the number of ideas a person produces, the higher is his fluency ability. Flexibility is the ability to produce ideas that show a person's movement from one category of thinking to another category, or shifts in thinking. It indicates variety in thinking. Originality is the ability to produce ideas that not many people can think of or that are unusual. Elaboration is the ability that enables a person to go into the details.

There are a number of strategies and techniques of teaching to develop creative abilities in the children (Bhaskara, 1981, 1990, Nirpharke, 1978). The investigator has made an attempt to promote fluency and flexibility abilities through different school subjects in fourth grade students.

### **Objective**

The objective of the study was to promote fluency and flexibility in Class

IV students through Oriya language, mathematics and environmental studies (science)

### Methodology

Forty-six students (28 boys and 18 girls) of Class IV studying in a rural school in the DPEP district of Dhenkanal, Orissa constituted the sample of the study

Five concepts from each of the subjects of Oriya, mathematics and environmental studies (science) were selected from the textbooks of Class IV. On the basis of these content areas, different forms of creativity emerged such as verbal creativity and literary creativity etc.

#### *Creativity through Mother*

##### *Tongue: Oriya*

The content-related creative activities such as guess consequences, problem-

solving, reasons finding and just suppose were prepared. These activities were administered in free, game-like situations as per Wallach and Kogan's (1965) procedure. The objectives of the creative activities along with their details are given in Table 1.

The teacher initiated the above activities by giving directions as given below

"Today let us play some interesting games. They will give you a chance to imagine many things. Remember, this is not a test. There are no right or wrong answers. So work on your own and let us see how many ideas you can think of. Feel free to give as many and varied responses as you can. Give the kind of responses that nobody else in your class can think of. Make your responses clever and interesting. If you run out of ideas,

TABLE 1  
Creative Activities in Oriya Language

<i>Language Area</i>	<i>Objectives</i>	<i>Creative Activities</i>
1 Word-making	To make words	Pupils were asked to write different words starting with 'Da', 'Fa'
2. Composition	To guess the	Write different consequences — If cows go on a strike
3. Give similar examples (instances)	Problem-solving	Give similar instances—a pen breaks during writing.
4 Composition	Reason finding	When a bus breaks down—what might be the possible reasons for this happening?
5 Story-writing	Just suppose	What would happen, if you could fly? Write as many responses as you can.

do not give up. Continue to think and you may have some more ideas that you can add to your list. Try to work as fast as you can." Emphasis was given to think in their mother tongue for finding fluent and flexible responses. A similar procedure was followed for mathematics and environmental studies (science).

It was ensured that each pupil could follow the directions, the task to be undertaken and the way the responses are to be given. During the activities, the teacher encouraged self-thinking and free flow of a large number of unrepititive, flexible and uncommon responses.

## Scoring

The response sheets were hand scored. The responses were examined for their scores for quantitative purpose. Only correct and unrepetitive responses were scored for fluency and flexibility. For each scorable response, a score of one was given and the total number of scorable responses constituted the score on the fluency dimension of the activities.

The responses of all the children given on an activity were classified into certain categories. Names for each category of responses were given. Depending on the meaning of these reponses, these categories were generated. There

## Creative Activities in Mathematics

TABLE 2

Creative Activities in Mathematics

<i>Mathematics Area</i>	<i>Objectives</i>	<i>Creative Activities</i>
1. Angles	Ability of drawing conclusions	Draw different types of angles, classify them and measure the angles
2. Triangles	Observe, classify and draw implications	Draw triangles, classify them, change side of the triangle and measure the angles
3. Circles	Product Improvement (circle test)	Take as many circles as you would like to take and prepare figures by adding details, but the circle must be an essential part of the figure
4. Geometrical figures	Preparation of designs	Use any or all these geometrical figures and prepare as many types of designs as you can ( $\square$ , $\circ$ , $\triangle$ )
5. Geometrical figures	Giving instances	List as many things as you can, where any of the geometrical figures can be observed

*Creative Activities in Environmental Studies (Science)*

TABLE 3

**Creative Activities in Environmental Studies (Science)**

<i>Environmental Studies</i>	<i>Objectives</i>	<i>Creative Activities</i>
1. Food items	Independent in exploring ideas	A number of circles of equal size drawn on a sheet of paper were given to the children, and they were asked to name as many food items as possible out of these circle(s) as an element.
2. Pumps	Guess consequences	Suppose there are no pumps in the world. What will happen? Think of as many consequences as possible which others may not think of
3. Animals	Use of animals	Think and write the number of ways that domestic animals are helpful to us
4. Machines	Finding a variety of similarities	Name the machines that are similar to the biological system.
5. Conservation of resources	Unusual uses of water resource	Pupils were asked to write different ways in which waste water could be used

was no limit to the number of categories for an activity. These categories were broad-based and independent of each other. As far as possible, common categories for all the activities of subjects were generated and, whenever necessary, to accommodate an uncommon response a new category was created. For each flexibility category, a score of one was given. Thus, the total number of flexibility categories under which the responses of the individual child belonged constituted flexibility of the child.

**Results and Discussion**

To study the promotion of fluency through creative activities in the children, the mean fluency scores in the activities are depicted in Table 4.

It is observed from Table 4 that the mean fluency score of each subject increases by and large from activity 1 to 5. It means that when the creative activities are conducted, the fluency ability of the children increases.

Table 5 reveals that the mean flexibility score increases from activity 1 to



TABLE 4  
Mean Fluency Scores in Different Subjects

Activity	Oriya Language	Mathematics	Environmental Studies (Science)
Activity 1	7.38	6.31	9.03
Activity 2	8.38	6.23	7.35
Activity 3	8.48	9.45	8.85
Activity 4	9.05	7.01	5.81
Activity 5	9.65	10.05	8.64

TABLE 5  
Mean Flexibility Scores in Different Subjects

Activity	Oriya Language	Mathematics	Environmental Studies (Science)
Activity 1	3.28	2.30	3.13
Activity 2	3.46	2.05	3.14
Activity 3	3.51	3.45	3.85
Activity 4	4.01	3.08	2.41
Activity 5	4.02	4.18	3.19

5 in all the three subjects, with some exceptions, especially in environmental studies (science)

### Conclusion

It is found from the study that subject-related creative activities can increase the fluency and flexibility in Class IV children. At the primary level, teaching

facts and thinking processes are equally important. The teacher cannot use all the contents of every school subject for the promotion of creativity. Therefore, the teacher has to analyze the content of each school subject and decide which topics are more suitable for promotion of fluency and flexibility.

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# Developing Creative Thinking through Work Education

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## Abstract

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*Every person has been endowed with the spark of creativity, which he/she tries to express in one way or the other. The notion that creativity is the sole prerogative of a few selected individuals has been proved to be erroneous. The next millennium is likely to bring many complex problems that would require persons who can think creatively, question the known, the obvious to reach the unknown and the unusual. The present paper focuses its attention on the development of creativity through the activity-oriented curricular area of work education. It exemplifies a few situations in the teaching-learning of the subject to illustrate how the students can be involved actively to think and manipulate ideas and resources, thereby triggering in the process of creative thinking for bringing in improvement, modification, invention and innovation in their products or services*

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**C**REATIVITY is a natural endowment of the human being. Within human nature rests the capacity to go beyond the existing present status. Man in this sense is the bearer of the creative process (Sen Gupta, 1984). "He is a unique representation of the universe in whom the unconscious creativity of nature becomes conscious creativity" (Radhakrishnan, 1960). The creativity, when carefully nurtured, consciously developed and effectively utilized, manifests itself in the form of new approaches to traditional problems, thereby contributing to innovation and change in a product, process or technique. Torrance (1967) states that the old myth that creativity is the function of superior genes and that the 'talent will come out' has been exploded. Today the researchers and theorists are in agreement that every individual is creative in a greater or lesser degree and that the development of creativity cannot be left to chance. Studies on the possibility of improving creativity by deliberate attempts have shown encouraging results. Crawford (1954) maintains that it is as foolish to say that the process of creative thought cannot be taught as to say that medicine or engineering cannot be taught.

During the last three to four decades, the world has witnessed unprecedented explosion in major areas of knowledge, technology, population and aspirations (Saraf, 1996). As aptly summarized by a thinker the situation is, 'When I thought

I knew all life's answers, they just changed the questions'. Questions in life are changing very fast. In such a rapidly changing scenario, particularly in a developing country like India, the critical role of creative innovation cannot be overemphasized. Beset with kaleidoscopic changes that give birth to a number of complex socio-economic and emotional problems like terrorism and violence, erosion of basic humanitarian values, poverty, illiteracy and consequent health and environmental problems, inter-state river water disputes, petty political rivalries, it is imperative to train a different kind of human being who is comfortable with and enjoys change, who is able to improvise, who realizes the uniqueness of the problems and is able to face with confidence, courage and creative talent any eventuality about which he has no forewarning. The society which can turn out such people will survive and which cannot will die (Maslow, 1954).

### **Education for Knowledge Reinforcement**

J.P. Guilford once stated that "all humans are born geniuses, but half of us are made idiots by the system of education". In his structure of intellect model Guilford had shown that there are as many as 120 ways of being talented. But "through education we are only reinforcing the development of academic talent in a narrow sense" (Raina, 1977). As a part of this

reinforcement the schools deal with various aspects of life through a variety of well-structured subjects in a well-planned and systematic manner. To this date textbooks are the main tools of transferring knowledge. Through innumerable tests and examinations the child is made to believe that each and every problem on earth must have one right answer. With this pious belief the boys and girls leave the portals of schools and colleges. But alas! they eventually discover to their utter bewilderment that they come across many questions in every walk of life—be it a teacher, a general administrator, a politician, a doctor or an engineer—which have no single right answer.

### **Variety in Responses**

Many questions will invariably elicit more than one right answer, like (a) In how many ways can you use a daily newspaper, (b) In how many ways can you separate two bodies from one another, (c) How can the present cross-border terrorism be put to an end?, and (d) How can population growth be effectively checked within a given period of time? etc. However, the number of responses and their variability, originality and uniqueness will possibly depend upon the variety and depth of experiences of the respondents, their imagination and of course their capability for divergent thinking.

The products of the present education system being drilled and grilled to

search for only one right answer, when faced with a complex immediate problem in real life, fail to divert from the obvious, the usual and the known. Many of the present-day socio-psychological problems are the gifts of modern-day ethos. Complex problems of tomorrow like the one posed by the recent hijacking of the Indian Airlines plane would require persons who can think quickly, intelligently as well as in a variety of ways, who are capable of tolerating the complexities and ambiguities of the situation and are able to sift satisfactory solution(s) from a variety of alternatives. They should be ready to question the known, the obvious to reach the unknown and the unusual.

### **Curiosity Generates Questions**

According to Sri Aurobindo, wisdom is born when reason dies; before this grand liberation man can only have knowledge (Dey, 1994). In fact, the genesis of all creative thinking and actions is in the questioning mind. The Upanishads have used questions as a basis of developing new ideas and knowledge. The characteristics of a questioning mind are: curiosity to know, reflective thinking, imagination and emotional thrust. Thus, emotional literacy and emotional intelligence gain significance in this context. As indicated earlier, changes in the contemporary society are rapid and too many, economy is becoming global and so also are the problems and calamities. Values and loyalties are changing fast

and man is seeking happiness and stability through material gains and technical superiority. While survival itself is at stake, the system cannot continue to perpetuate mediocrity, indecision and conformism. The elements responsible need to be discarded sooner than later in favour of encouraging initiative, allow innovations, sustain excellence and face the emerging challenges creatively.

Therefore, young minds who are likely to face many such unconventional challenges require to be trained not only in the coverage but also in the diversity of their thinking to arrive at a number of probable solutions to complex problems, evaluate each for appropriateness and practicability, and try them singly or in different combinations.

Unfortunately, the educators as a group have yet not realized the need to develop such divergent thinking abilities in children, which are essential for creative problem-solving and innovative decision-making. A careful analysis of the transactional process in the formal system reveals unflinching reliance on giving readymade knowledge systematically and neatly organized in the form of units, lessons and textbooks. The entire syllabus is prescribed and the child as well as the teacher are required to follow it rigidly (Mehdi, 1977)

The child thus develops into a storehouse of information, a good receiver of given knowledge, a good memorizer and a good convergent thinker. As a matter

of fact true education and training should instead kindle that spark of creativity in each child that would make the task of learning more satisfying, more exciting and meaningful rather than being a drudgery as at present

### How to Develop Creativity

The question therefore arises how to develop creativity? In order to develop creativity in a classroom situation it is necessary to create an atmosphere of psychological safety. The children should feel free to express their ideas without any fear or pressure from any quarter. There should not be any emphasis to maintain uniformity or ensure conformity. Efforts should always be made to encourage self-initiated, independent, constructive responses. Such a permissive classroom climate is possible only when the curriculum is flexible with provision for change, and evaluation is continuous and comprehensive rather than being a one-time affair. The time-table, the teaching strategies, the classroom seating arrangements and mode of interaction will have an element of flexibility. Seen in this backdrop it is found that the syllabi of scholastic subjects are by and large rigid, with clearly defined boundaries. Examination-dominated teaching-learning process makes the situation still worse.

A silver lining in the otherwise drab curriculum can be perceived in a relatively new but potential curricular subject of work education, which "would

comprise activities in accord with the interests, abilities and needs of students..." (NPE, 1986) As stipulated in the National Guidelines (NCERT, 1987) at the primary stage, a variety of creative and self-expressional activities are to be made available to the children. The schools can be provided with an open list of activities with a great deal of variety suited to the intellectual and physical development of the children. At the upper primary stage, exploratory activities and work situations are provided, wherein learners explore tools, materials and techniques. In the process they also discover their own talents and capabilities. Acquisition of skills for selection, manipulation, estimation and communication acquire prime importance at this stage. Crystallization of ideas and potentialities takes place at the high school stage. Manual work activities within the area of work education when done intelligently provide vast opportunities for initiative, creativity, cooperation and freedom (Sen Gupta, 1990). Community work and social service form an important component of work education. These activities aim at developing in students favourable attitudes towards social integration, service, emotional expression, innovation, problem-solving and a spirit of enquiry (Sen Gupta, 1989).

### **Phases in Teaching-Learning**

The Review Committee on the Curriculum for the Ten-Year School (Government of India, 1977) recommended three

phases in the teaching-learning process of this subject. These are (a) exploration of the world of work through observation and enquiry, (b) experimentation with materials, tools and techniques, and (c) work practice. Further, the entire evaluation in the area of work education has been seen as a continuous process, to be internally conducted by the teacher teaching the subject. The activities may differ from school to school and place to place, depending upon the needs and resources. Therefore, no fixed programme can be prescribed for all the schools in an area, let alone in a state or in the country as a whole. The guidelines also provide for out-of-school hours for productive work and community-service besides the time allocation within the school time-table.

Thus each school is given enough freedom to choose the activities and to implement them by drawing out their own annual plans. Evaluation being continuous and internal, the subject is free from the pressure of external examinations. In other words, the subject of work education provides immense opportunities for the development of these abilities and for the inculcation of these personality traits which have been identified as contributing to creativity and divergent thinking.

### **Measures Conducive to Creativity**

Research findings on creativity (NVS, 1989) suggest several measures conducive to creating favourable environment

in the class or school, to facilitate the development of creativity among children. One of these is to pose open-ended/divergent questions in the classroom wherever possible. These provide scope for many possible answers, but none of them is wrong. By taking an example of, say, candle-making, a popular activity under work education, one can easily demonstrate how this strategy can be applied.

Preparing candles in hundreds, packing them and selling them during Deepawali is commonly practised in many schools as a part of conducting this activity. In doing so the schools demonstrate a factory orientation and not that of an educational institution where "manual activities should find a place in the curriculum not because the pupils or some of them will earn a living by manual labour but because satisfaction of the desire to make or create is necessary to balanced development" (Wood and Abbott, 1937) The Zakir Husain Committee on Basic Education also expressed similar views when it said "(Manual work) provides vast opportunities for initiative, creativity, cooperation and social service".

### **Children's Participation**

In order to successfully exploit the educational potential of this activity in favour of creativity and innovation, the teacher may contrive the transactional process into a child-centred one by involving active participation of children and

simultaneously posing certain open-ended questions like

- Why do we use only wax to prepare candles?
- Can we replace it by any other material?
- Can we re-use the left-over wax for producing more candles? If yes, will the efficiency/illuminating power remain the same?
- What should be the optimum length and diameter of the candle for optimum results?
- Can we have candles of any length or girth?
- How can we make candles of different shapes, and of different colours?
- How is it possible to enhance the burning time of a given candle?
- How can we prepare candles giving flames of different sizes, different colours etc.
- Why do we always use a particular type of wick? Can we use any other type?

In this way, by a series of questions, students may be led from the known to the unknown or from familiar to new ideas, triggering in the process creative thinking for bringing in improvement, modification, invention and innovation.

Similarly, another research finding in this context advocates assigning projects or activities to children that call for original thinking or expression depending on



their special areas of interest. In order to exemplify this idea, let us consider a project like constructing a table-lamp for one's use. Usually in a typical classroom the teacher who acts as a prime mover, informs the students about the project to be prepared. He/she lists down in detail the materials and tools required, sketches the diagram on the blackboard and finally keeps all the materials ready—cut to size for assembling after doing minimum of manipulation and finishing.

In the whole exercise described above it can be seen that almost no thinking is involved on the part of the students. As an alternative strategy, the participation of the students may be ensured right from the need-assessment stage. Let the children spell their individual needs and requirements for a table-lamp. Complete freedom is to be given regarding materials to be used, and then size, shape, assembling mechanism, colour etc. There is hardly any justification at this stage to compel students to conform to the norms given by the teacher. Instead, the teacher becomes a facilitator of learning rather than dominating the teaching-learning process. He/she should in fact encourage more of diversity, peer interaction, use of new and uncommon materials, inclusion of novel features in construction etc. The whole process is to be so contrived that it agitates the thinking and spurs the imagination of children. Manifestation of variety, ingenuity and diverse need

satisfaction may result in 40 students producing 40 different types of table-lamps, each with unique features reflecting the aesthetic talent and creative productivity of the children.

### **Scope and Flexibility in Work Education**

Thus the area of work education with its vast scope and flexible nature provides ample opportunities for experimentation. Due to its suggestive rather than prescriptive curriculum at the national/state level, the sky is the limit for innovations in content, methodology and school-community partnership. An activity like garment or textile designing provides opportunities for experimenting with various designs, colours, blocks and techniques. Food is yet another potential area where children may experiment with different recipes, table decoration, flower arrangement etc. Evolving computer-assisted carpet designs and san prints can provide innumerable possibilities for manifestation of creative talent and imaginative potential. What is required therefore is a change in the approach. Teachers should avoid over-emphasizing textual information. They should provide supplementary materials, promote skills of enquiry and problem solving like raising questions, making guesses, testing guesses, correcting errors and communicating freely their conclusions. They may also try new ways of teaching the same unit, using a

variety of teaching aids to stimulate exploration, imagination, curiosity and inquisitiveness in children.

While it is hardly possible to present a prescription for teaching creatively, there are a variety of approaches, classroom strategies, skills, materials, relationship with pupils and other aspects of teaching that might go to nurture creative potential of children. However, this

would require that the teacher first understands what is meant by creativity, how to identify it and finally how to promote it. The curriculum, evaluation system, methodology of teaching, classroom questioning, textbooks and the teacher's attitude towards the creative child need considerable modification and change in favour of creativity and innovation.

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# Fostering Creativity through Science Teaching in Schools

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## Abstract

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*Creativity is a developmental process which flourishes best in a free and relaxed atmosphere in a truly democratic set-up. In this article, it is suggested that at the pre-primary stage, to promote divergent thinking amongst students, their stretch of imagination needs to be enhanced through an open system of education. As students mature in age and mind, their divergent thinking capability may be given credence through attributes leading to remote association. At the still higher level of schooling, it is being advocated that students may be trained in problem solving through brainstorming. Brainstorming promotes students deriving inspiration from other students rather than a student deriving inspiration from the teacher.*

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**C**REATIVITY is a highly precious, fascinating human endeavour. It is difficult to bind creativity in words; nevertheless creativity may mean to carve out something new, may it be original or may it be the outcome of critical analysis of the existing ideas. Creativity is a thinking process. Creative thinking differs from critical thinking in that it is concerned with new ideas as opposed to previous ideas or reflections on someone else's ideas. Creativity is the act of drawing on all past experiences and the act of selection from those to yield a construct of new patterns, new track of search for destination, new thought process, new styles, new designs or new products. This newness is the focal point to creativity, which is organically linked to its contribution to the society. However, if an elementary school student gives birth to a new idea new to him/her, this should temporarily be regarded as sufficient evidence in the framework of creative act. His/her talent needs to be appreciated and his/her contribution to the society can come later. As an illustration, if a student argues that two elements, hydrogen and oxygen, combine to form water, designated  $H_2O$ , then why not the compound  $HO_2$  is possible. This behaviour of the student positively reflects that she/he has the ability to challenge the existing ideas and possesses creative mind, which needs to be nurtured and cultivated properly for the benefit of the individual and the society.

## Towards a Creative Classroom

A creative classroom is sometimes misinterpreted as one where anything goes. This should not be the case. The expected behaviour of the students and the mode of operation within the classroom should be revealed to the students, as the students operate best when they understand the framework within which they must operate (Yager et al, 1988). Children give birth to the new ideas best in an atmosphere that is relaxed, where thought process of each one is equally respected and every individual gets a chance to put forth his/her view point. Students show positive inclination towards creativity when their needs are recognized, met and appreciated. Creativity best flourishes in a climate of independence, and independence demands maturity as a pre-requisite. It is developed slowly. The paradox of the situation is that in India mostly students are not given the opportunity of developing this maturity throughout their entire school career.

We, as teachers, must work at being creative; we should set a model of being a creative person in our approach of imparting classroom instruction. If creativity in the sciences is to continue to be a joyful act for students, this joyous activity must first of all be reflected in the behaviour of the teacher. Thus to be creative in our classroom, we may keep in focus the following broad principles of James A. Smith (1966) while transacting a curriculum:

- Help students in developing creative power.
- Provide open-ended learning situations.
- Train students in the art of divergent thinking and allow them to end in productive outcome.
- Encourage problematic situations put forth by the students and engage them in problem-solving pursuits.
- Provide positive reinforcement to the creative ideas of the students
- Inculcate the habit of tolerance for creating new ideas.
- Make students critical in their approach rather than being receptive.
- Practise friendly and democratic approach in the class.
- Nurture creativity as a process.
- Help children in developing the feeling that all areas of curriculum are instrumental in developing learning.
- Develop skills of constructive criticism amongst students.
- Train students in the art of diverse approaches to the solution of problem solving.
- Discourage in students the habit of reliance on authority
- Help highly creative individuals to promote this curiosity and strong convictions
- Dehemphasize perfection at early levels of thinking
- Strengthen the feeling amongst the students that all individuals are creative.

## Creativity around Us

Creativity is something everyone possesses in varying degrees, it occurs at almost all ages and in all fields of human endeavour. A creative artist or a musician produces a novel, original, unique painting or music piece. A creative cartoonist produces a new cartoon representation of existing behaviour. A creative engineer produces new original/unique ideas or products. It is generally accepted that creativity is a highly desirable and precious activity, prized by teachers, scientists, engineers, industrialists, politicians, advertisers and others, so much so that the persons who give analogies to illustrate their view point, dramatize a skit that is a satire on the society and produce wits that are also labelled creatives because the element of newness is central to their act. Teachers too are dubbed creative, which produce new unique situations conducive to learning, wherein students are doing new things. Creativity can only be developed, and its development depends upon the environment into which it is introduced and circumstances that condition it. Despite past researches and currently in progress, little is known about the experiences and conditions that foster creativity. However it is generally felt that creativity can be developed in students if in the learning process the teacher provides creative situations to which students can react accordingly.

### Promoting Creativity in Our Schools

Creativity is a developmental quality like love, a quality already present in every individual; it only needs to be coddled to help it grow. The less-creative children in our schools today are living testimony to the degree to which it can be killed off easily. Once it appears on the surface, its reappearance can be assured by use of all the techniques that cause behaviour to reappear. But it does not appear unless certain conditions are present that cause it to come forth. If we want creativity to flourish in our classroom, the first and foremost thing is that we have to bring openness in our instructional styles right from the primary stage of learning. The primary stage is the most important stage, because it is here that we would lay out the right foundation of promoting the culture of creativity in our students. We may at this stage create open outlook in our students towards their immediate environment. This act may be promoted by engaging them in the following types of activities, which are suggestive

Sketching out a given situation related to, say a mountain, a garden, a river, a scene at the platform etc., or involving them in pursuits like:

- (a) Through how many different ways can you determine the dimension of the classroom?
- (b) How would people suffer if it does not rain properly?

- (c) Explore the cause of seasonal changes around you
- (d) Suppose you need chairs for your garden or school. List out all possible modes through which you can design chairs

The target is to engage the class in imaging, as researches have shown that imagery is the hallmark of creativity (Vaune, 1982).

Now at the upper primary stage, the habit of free thinking inculcated in the children needs to be encashed. Keeping in view the developmental stage of the children, they may be engaged in search for inquiry about the situations they come across and the inculcation of the right spirit to explore the cause of the observed phenomenon. We may label this act as fostering creativity through situational experiences. The following two illustrations may highlight the viewpoint being put forth

#### *Illustration I*

Consider a common candle burning, many ideas and conceptual understandings intertwined with inquiry can evolve from a study of the burning of this common household candle. Some of the ideas that may engage attention could be purpose and qualities that a wick of the candle must possess, study of the structure of the candle flame and its comparison with other flames, designing of the candle where fuels other than wax may be present, preparing such candles where

efficacy of burning of wax may be enhanced, exploring the history of the concept of oxidation and role of oxygen in burning and several other processes, conditions that favour burning and the means and ways to control fire and the effect of disturbance of air currents on burning. Each of the ideas listed above is worth probing further. As an illustration, mention can be made of the role of oxygen in burning and several other processes. The new ideas worth consideration keeping in view the level of students may be:

- Role of air in place of oxygen as supporter of combustion and utility of other air components to humanity
- Mixtures and their interplay in our daily life situations (recalling that air after all is a mixture)
- Economical value of oxygen for steel industry and several other industries
- By-product of electrolysis of water and oxygen as one of these
- Importance of oxygen for our metabolic activities
- Appreciating the significance of afforestation for our existence.
- Exploring means and ways to get oxygen easily from several substances
- Enriching experience about incomplete combustion.

### Illustration II

Bread is a very common item of our breakfast. Very often it is seen that if stale (2-3 days old), the bread is at times covered with greenish matter. Growth is a topic that is commonly found in text of the upper primary stage. The students' experiences need to be enriched. Teacher may utilize this as a challenging situation and ask the students to explore the causes for the appearance of this greenish matter. Several points that may emerge from students' discussion are likely to be:

- Is it a growth? If so, then why? If not, then why not?
- How do we ascertain if it is a growth?
- What factors must have affected this growth?
- Why is growth a living system?
- What type of growth is it in terms of living being?

From these two illustrations, one can easily infer that if some originality has to come into existence, then divergent thinking is the nucleus of it. The emergence of ideas generated from divergent thinking continuously opens new horizons for thought. Students using divergent thinking to the solution of the problem begin to scan from new perspective. Once facts are reviewed or a new experiment is performed, students employ convergent thinking in a stimulating fashion. Hence this makes pattern of

thinking to change from divergent to convergent, and is reflected in a pattern called the divergent-convergent model for fostering creativity like Inducto-deductive approach to teaching. According to Guilford (1980), divergent production is related to creative functioning, whereas convergent production is related to intellectual functioning. Therefore, both these abilities are needed for problem-solving in the classroom. Hence the school teachers need to be thoroughly made aware of these ideas if we want them to transact problem-solving strategies effectively.

At the secondary stage, the student is supposed to be apt in combining proposition by conjunction (Piaget, 1969). The openness in teaching-learning process may be set to tune with writing of attributes of a particular object/substance. Attribute listing is one of the methods of promoting creativity, which was developed by Crawford (see Tripathi, 1995). According to him, in creative thinking we either change an attribute of some object that we wish to improve or borrow an attribute from some other object or situation and apply it to the one we wish to improve. Attributes of writing can also be applied to activities. The following illustration throws light on this issue.

### *Illustration III*

Chemical bonding is highly central to all teaching-learning processes in chemistry course content at the secondary stage.

The most common example given to students while providing conceptual track to electrovalent mode of linkage is sodium chloride. The teacher may ask the student to write possible attributes of this compound (sodium chloride). Students may be asked to do some exploratory work, using library or interacting with persons more knowledgeable than them. This may bring into focus several issues, noteworthy amongst these may be:

- Conduction depends upon several factors. For ions to cause conduction they need to be mobile.
- Size of the constituent particles in case of ionic crystals plays a dominant role in deciding the type of crystal likely to be formed.
- For a solute to be soluble in a particular solvent, it must effectively interact with the solvent.
- Ionic solutes normally get ionized in water and, therefore, their solutions contain hydrated ions. Solvation depends upon the nature of the solvent.
- Hydration of ions is a very important phenomenon that depends upon the shape and size of the ions.
- Ions, because of the difference in their physique, hydrate differently and this has several important biological implications.
- The use of Oral Hydration Therapy is linked to hydration tendency of ions.

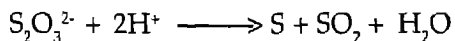


- Addition of electrolytic substances to sea in the form of effluents may disturb the water cycle in nature

It is of interest now to reflect the scope of divergent thinking that is hidden in each of these attributes. The elements of divergent thinking associated with point number 3 here brings into focus several issues. Few such issues are forces of attraction operating within the solute and solvent particles, dielectric constant of the medium, role of energy considerations in solution process, size of the solute particles, if solute particles are ions then charge possessed by these, role of temperature and pressure in solution formation and dominance of water as a unique solvent. The transfer of attributes from one phenomenon to the other, for example, energy considerations to the process of solution formation here termed "Remote Association", also encourages creative habits (Mednick and Mednick, 1964).

#### *Illustration IV*

While transacting the chemistry of the compound  $\text{Na}_2\text{S}_2\text{O}_3$ , the student comes across the following reaction.



The teacher promptly asks the students to down all possible attributes of the reaction. In a traditional type of teaching the reaction after casual mention may go un-noticed, but a non-traditional teacher would like to highlight several

new learning points through this reaction, thus providing opportunities for creative act. Prominent among these could be:

- Rate of precipitation of sulphur as related to nature of different acids and concentration of reacting substances
- Aqueous solutions of several substances tending to cause this reaction, thus strengthening the process of salt hydrolysis
- The different bonding modes of two sulphur atoms in the species  $\text{S}_2\text{O}_3^{2-}$  and their interplay in the reaction, thus highlighting the role of structures in the chemistry of substances.
- Differing capabilities of, and  $\text{H}_3\text{PO}_2$ ,  $\text{H}_3\text{PO}_3$  and  $\text{H}_3\text{PO}_4$  and other acids differing in their proticity to cause the said reaction.

#### **Promoting Creativity through Brainstorming**

At secondary stage, students are capable of abstract thinking and, therefore, occasionally they may be involved in brainstorming sessions. Brainstorming would inculcate some highly valuable qualities in the learners, noticeable amongst these are.

- Logical thinking, inculcating the ability of critical judgement.
- Patience to tolerate other's viewpoint

- Democratic and participatory methods of learning.
- Skills of selecting and rejecting a hypothesis.
- Search for alternative solutions to the problem being pursued.

Now to make classroom processes more effective, the first and foremost aspect for the teacher is to go in search of opportunities that are non-traditional and still more important than this is the faith of the teacher in his/her students. The pursued point of view is better illustrated by the following activities/ problematic situations.

#### *Activity 1*

Keeping in focus the aspect that nitrogen and oxygen cannot expand their octet, suggest a possible structure for the species  $\text{NO}_3$ . (It may be worthwhile to add here that this structure is not ordinarily available in the chemistry texts for school and college level.)

#### *Activity 2*

Suggest different possible ways by which you may analyze the sample of brass, which is supposed to be an alloy of copper and zinc.

The essence of brainstorming approach is that the process of generating possible solutions is separated from the process of evaluating these solutions. Brainstorming is a celebrated technique frequently said to facilitate creative problem-solving both for groups and for individuals (Osborn, 1963). Problem-

solving, in this respect, involves the following steps:

- (i) specifying the problem,
- (ii) getting information,
- (iii) generating possible solutions,
- (iv) evaluating these solutions, and
- (v) selecting one of them

Brainstorming has been found superior to the approach in which each possible solution is instantaneously evaluated (Meadow et al., 1959, Garsha, 1978).

#### **A Suggestive Pedagogy for Brainstorming leading to Cooperative Problem-Solving**

Undoubtedly, in our country little attention has been paid to problem solving and, if at all attempts have been made, the success rate in terms of quantity and quality is not encouraging. Students mostly do not venture to construct their own thought processes (Aggarwal, 1999). Therefore a method needs to be worked out wherein the students' motivation level is enhanced and this may help in making healthy classroom environment for the task in hand. Thus to tackle problems and to popularize problem-solving, particularly in science, the teacher may write the problem on the board. Randomly the class may be divided into five-six groups. Thereafter, the teacher may give some time to think over the problem afresh, and the students may discuss the solution to the problem in their groups. Either through

random selection or through volunteer system, one of the groups may start presenting the solution on the board while other students may analyze their work. The teacher may occasionally guide the presenting group if they get stuck up in solving the problem. After the initiating group has presented its solution, other groups turn by turn may comment upon it. The different groups may present their own solutions to the problem also if they have some novel solution, on which others may now comment. In this manner the classroom environment may be made interactive, where each group and every individual has an equal chance to contribute in the process of learning. This approach may help make even passive students active. Sometimes students do not simply take interest in the process of learning as it is not at all challenging for them. Psychologically also on students inspiring other students may prove to be better than the teacher inspiring the students. Researches are available which suggest that a better learning environment is possible through cooperative learning (Tingle, 1990; Brasili and Sanford, 1991). An unanticipated but quite powerful feature of the brainstorming technique is that the instructor can easily control both the content and level of the work, and discuss it in the class through proper selection of problem. As students mature in problem-solving the teacher may present reasonably challenging multi-step syn-

thesis problems to work upon. Such problems may be given as assignments and sometimes incubation time may be given to students to scan the problems properly. Incubation enhances the creation of useful ideas (Torrance, 1979). Group work followed by brainstorming may again be used to solve the problem. Typical problems in chemistry related to analytical work and elucidation of structures of organic substances through given attributes may serve as supportive ground for adopting this approach at XII grade of schooling.

In brainstorming, criticism is not permitted. If there are any pitfalls in a newly proposed suggestion, instead of pointing out these flaws and rejecting the ideas, members are asked to concentrate on constructive criticism. This would bring about some progress and a promising idea can be given a more practical and realistic shape. Evaluation in brainstorming is popularly also referred to as 'Deferred Judgement'. The chief advantage of group thinking over individual thinking lies in this principle. "A climate of supportiveness, relaxation, appreciation and collective responsibility is noticeable among the group of members which is conducive to productive session". As problem-solving so far is not a very favourable instructional strategy of our classroom, it seems reasonable to use brainstorming as a vehicle for switching over from group thinking to individual thinking, to train our students in the art of creative thinking.

## Conclusion

Creativity has been existing in the past and currently is also the hallmark of goals of education. The 21st century is going to be the century of creative thinking alone, because the world problems of the new century like proper water management, judicious use of land, effective agricultural areas and means of production, better quality of air for our survival, proper coordination among each other in this nuclear age and several others would require altogether new creative thinking strategies. It is the real challenge before the humanity, whose beginning needs to be made in schools, that too from the early years of school education. In a country of billion persons, as India, enough creative persons are available and a sizeable number amongst these would be the school-going children. What we need is to spot

these out and cultivate in them creative habits for the ultimate benefit of the society, and this can be achieved only by placing creative children in the company of such teachers whose own acts spread creativity. This shows that our teachers' training has to be geared up to prepare teachers who encourage openness, freedom of expression, value risk taking by their students and above all appreciate every bit of ideas by their students. Darnell, et al. (1999) also share the opinion that to turn into creative learners, students value their independence in the classroom and their freedom to express their creative ideas without fear of interpersonal judgment. Notably, this individual approach may be more difficult in larger classrooms. However, it is still an important classroom goal for the teacher when he/she attempts to induce a creative learning environment

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# Promoting Divergent Thinking in Class X Students through Classroom Questions

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## Abstract

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*Men of eminence have used thought-provoking questioning technique to improve our lives by applying "contrary imaginations" in almost all walks of human endeavour. Guilford's structure of the intellect clarifies that thinking is carried out through cognition, production and evaluation. Productive thinking has two well-defined shades, i.e. the convergent production category and the divergent production category. The latter has been designated as creative thinking. It has four major components: fluency, flexibility, originality and elaboration. A unit, Food Production, from the Class X textbook of the Central Board was selected to show how to promote divergent thinking in these students through classroom questions. This unit has been sub-divided (8) and what concepts each of them contains determines the kinds of questions that could be raised.*

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**T**HE present status of our world civilization in all walks of life had been based on skills. Guilford's (1956) structure of the intellect clarified that thinking is of three types, i.e. (a) cognition, (b) production, and (c) evaluation. Productive thinking has two shades, i.e. convergent-production category and the divergent-production category. To the former are attributed abilities that almost always end up with a conclusion or an answer; hence it is also designated with intelligence. In divergent thinking, on the contrary, there is much searching about or going off in various directions. Therefore, it has been characterized as being less goal bound. Unlike in the convergent thinking, in the divergent thinking (creativity) a variety of ideas, all of which have possibility of occurrence in view of a given information, are generated by the respondent. In doing so the individual freely constructs his/her own data as tentative solutions of a problem. Through factor analytic studies, Guilford (1980) has shown that 'creativity' involves divergent production and transformation. Subsequently, he included the redefinition ability as part of the convergent-production category and sensitivity to problems has been assigned to evaluation category. Torrance (1965), however, defines creative thinking as "the process of searching gaps or disturbing, missing elements, forming ideas or hypotheses concerning them,

testing these hypotheses and communicating the results, possibly modifying and retesting the hypotheses". Mostly, commonly employed dimensions of creative thinking ability had been fluency, flexibility, originality and elaboration.

Like intelligence, creativity is also a normally distributed attribute in a population. But the latter does not bank on the genetic make-up of the individual. Therefore, it is mainly developed through individuals' interactions with the objects, persons and the phenomena of the immediate environment. Creativity, therefore, is enhanced by training. Hence, the teachers need to understand the nature of creative abilities and how to develop/nurture them in their students. They also need acquaintance with the methods and techniques of promoting creativity. The role of classroom questioning technique, therefore, has been suggested as one of the many methods that are available to the teachers for improving creative functioning of the school children.

From time immemorial, men of eminence (either creativity and/or intellectually gifted) had been exploiting thought-provoking questioning technique for solving various kinds of problems, be they individual or social in character. Today's improved life-styles have come up because of such individuals who applied 'contrary imaginations' for the benefit of mankind. Indian scriptures have also used thought-provoking

questioning technique as a basis of developing new ideas and knowledge. For promoting divergent thinking in students, it has been suggested that the classroom questioning be pivoted on the following characteristics.

In the first instance such classroom questions should have multiple responses besides other characteristics such as. (i) providing curiosity for exploring the unknown; (ii) bank on reflective thinking; (iii) employ imagination and (iv) be geared to attitude to questioning mind. All these four characteristics of a question form a desirable prerequisite for engaging in productive problem-solving.

In order to develop divergent thinking in Class X students in science subjects, the following unit has been taken from the Central Board of Secondary Education (CBSE) Syllabus, 1998.

#### *Unit : Food Production*

For the purpose of developing divergent thinking, the unit has been divided into sub-units, to determine the major concept each of them contains.

##### *Sub-unit : Primitive Man*

The concepts included under this sub-unit are: Dependence on animals for food and development of stone tools, knowledge of sowing seeds and identification of right species of plants.

How the teachers can foster divergent thinking in her/his Class X students through classroom questions are suggested below.

Q 1 . How primitive man would have survived had he not developed the stone tools?

Q 2 : What would have happened to life on the earth if the process of sowing seeds was not developed?

Q 3 : Suppose the primitive man did not use the selection of right type of species of plants; how he would have lived then?

##### *Sub-unit : Soil*

The concepts included under this sub-unit are functions of soil, preparation of soil, levelling, manures, manuring and sowing.

Q 4 : How plants can be grown without soil?

Q 5 : What would happen if the seeds are just thrown in the field?

Q 6 . Why in crops like paddy the seeds are not directly sown in the fields?

Q 7 . What would happen if the same crop is raised in a field continuously for three years?

Q 8 . Estimate the effects of water-logging immediately after seeds are sown in a 30 m x 30 m field.

Q 9 : Construct hypotheses on how nutrients of a soil can be improved upon.

##### *Sub-unit : Irrigation*

The concepts under this division are importance of proper irrigation, amount



of water, nature of soil and sources of irrigation

Q 10 : Suggest ways/means of irrigation in a desert type of climate.

Q 11 : What would be the consequences if field is continuously watered after the seeds have germinated?

Q 12 : Why the nature of soil is important for the purpose of irrigation?

Q 13 : Suggest what crops can be grown in a desert area.

#### *Sub-unit : Control of Weeds*

This sub-unit includes concepts like weeds and their control

Q 14 : Why are the weeds not useful?

Q 15 : How can weeds be used by farmers for their benefit?

Q 16 : Weeds are undesirable plants. How can they be made useful for the benefit of the society?

#### *Sub-unit : Control of Pests and Plant Diseases*

The sub-unit includes control of pests and plant diseases

Q 17 : What would happen if we do not protect our crops from diseases and pests?

Q 18 : Suggest methods by which farmers can control the pests and plant diseases

#### *Sub-unit : Improved Varieties of Crops*

The concepts of this sub-unit are high yield disease resistance and quality of crop produce.

Q 19 : What consequences the man would have faced if the varieties of plants were not evolved by scientist?

Q 20 : How the new varieties of plants can be harmful for man?

#### *Sub-unit : Harvesting*

The concepts included under this sub-unit are manual harvesting, harvesting through machine (combine) and threshing

Q 21 : Suggest different methods to know that the standing crop has matured for harvesting.

Q 22 : Why is manual harvesting avoided by the farmers?

Q 23 : Suggest consequences if it rained before harvesting?

Q 24 : What problems would the farmers face if the harvesting of crops is not done by the harvester?

#### *Sub-unit : Domestic Animals*

Feeding, shelter, care and management are important concepts of this sub-unit.

Q 25 : How would life activities of a milch cow be affected if it is not given green foodstuff?

Q 26 : List causes for why animals feel uneasy.

Q 27 : Prepare a list of domestic animals according to their utility for man and suggest the reasons for utility.

Q 28 : On a winter morning you were waiting at the cow-shed. You had observed that wall and roof of the shed were completely damaged, floor was *kachcha* and the surface uneven. Make conjectures why it is not good for the animals.

Q 29 : Imagine how the human beings can survive if all the crops are destroyed by a very big storm.

Q 30 : Imagine what would happen to farmers if all their domestic animals die due to a disease.

The author sincerely hopes that the suggested types of the questions would promote divergent thinking in the students. The teachers (it is expected) would create such questions in other units/areas for the improvement of productive thinking in their class.

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# Problem-solving Activities for Senior Secondary Biology Students

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## Abstract

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*The human brain uses both the hemispheres for processing of information. The left one does it in a convergent fashion, whereas the right one utilizes a divergent mode. Scientific problem-solving, however, needs convergent as well as divergent thinking. The author has tried to demonstrate how these two modes of thinking can be promoted through biology content materials.*

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**S**CIENCE as a domain of human learning is as old as man himself. Human brain employs right and left cerebral hemispheres in thinking and problem-solving. Of the two cerebral cortices, the right one processes information in divergent modes. The left one utilizes convergent thinking patterns (Guilford, 1977). Scientific problem-solving employs both the hemispheres of the brain. Hence, critical and creative processes are involved in scientific problem-solving (Pachaury, 1990). Both Getzels and Jackson (1962) and Torrance (1963) reported that to "assess the ability to raise questions and identify problems are as one of the indices of creative thinking".

### **Problem-Solving by Convergent Thinking**

Thinking required through this mode of problem-solving is directed towards a special goal. Well-defined problems are solved through this procedure, because they bank on gaps, inconsistencies and disharmonies. Torrance (1965) considers them as acts of creative behaviour in the development of a domain of knowledge. Creation and empirical testing of a hypothesis are also true acts of creativity (Rogers, 1970). Therefore, steps of scientific methods have been considered as convergent type of problem-solving. The major concern of the problem solver in this kind of activity is to create mental models of discrepant events for solving a given problem (Johnson-Laird and Bryne, 1991, John-

Laird et al., 1992). Convergent problem-solving according to Hunt (1982) is carried through in two stages. In the first stage, selective encoding is done and then the existing knowledge structure is matched with it. Through the process of incubation then as a second stage an output of choice, i.e. a solution, is spelled out. The cognitive process of solving a well-defined problem through convergent thinking entails deductive reasoning methodology.

### **Problem-Solving by Divergent Thinking**

Chief characteristics of this type of problem-solving is designated as free thinking. Open-ended problems are invariably solved in this manner. In contrast to convergent thinking, divergent problem-solving is highly flexible and, therefore, does not employ a well-defined procedure for attacking it. Many a times, the solution of such a problem has high originality. Whatever be the modes of problem-solving by divergent procedures, it involves some kind of a transformation (Guilford, 1950). Problem-solving by divergent modes of thinking essentially generates a new representation for existing realities.

On the basis of the above descriptions, scientific problem-solving involves convergent as well as divergent thinking strategies. In the next section, some activities have been suggested for the nurture of higher order thinking abilities in secondary biology students.

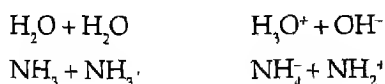
Gifted children have been displaying the following characteristics.

- independent and non-conforming behaviour (Gallagher, 1969, Geortzel and Geortzel, 1962);
- tolerance for ambiguity and asymmetry (Barron, 1963),
- sensitivity to problems (Guilford, 1977),
- possessing unusual imagination and intellectual curiosity (Laycock, 1957);
- understanding the deeper levels of interpretations (Strana, 1959);
- ability to generalize seemingly unrelated details, and
- exceptional memory (Brandwein et al, 1958); and
- IQ 120 and above

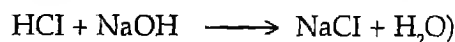
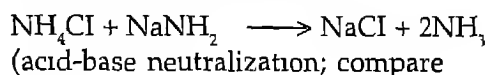
The first two activities mentioned below, therefore, have been suggested for the gifted children. Average students can also try them at their own level of understanding

### Origin of Life

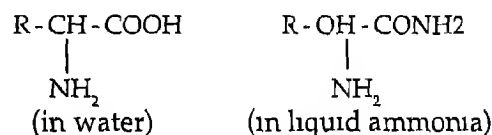
On our planet (the Earth), the life processes occurred in water, but liquid ammonia too has also isomorphic properties like high dipole moment, high dielectric constant, auto-ionizing properties, hydrogen bonding, and therefore could support a similar biochemistry. Below is compared autoionization of the two solvents.



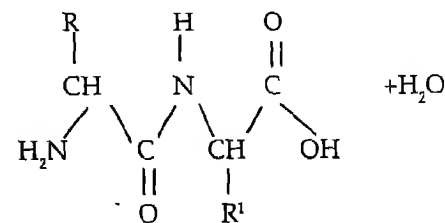
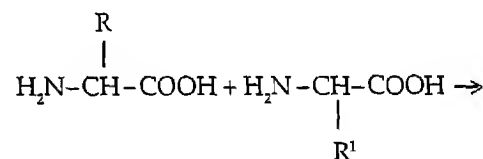
Ammonium ions (e.g.  $\text{NH}_4\text{Cl}$ ) will be acids in liquid ammonia, and substances that produce amide ions (e.g.  $\text{NaNH}_2$ ) will be basic. The following reaction represents the liquid ammonia analogue of simple aqueous reaction.



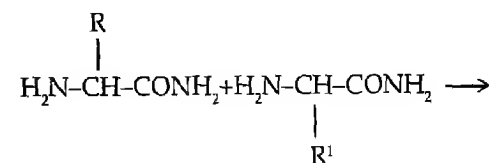
In liquid ammonia the amides of amino acids would be analogous to amino acids in water.

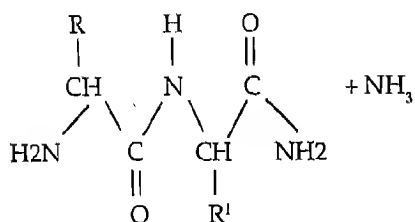


The formation of peptide bonds in aqueous solution occurs thus.



In liquid ammonia it would become:





Answer the following questions:

1. Jupiter's environment is ammonia rich; could life be developing there or be already there in existence? Why?
2. Which other compounds could also support the phenomenon of life? Why?
3. How would organisms be utilizing alternative biochemistry of compounds like boron, silicon, germanium, nitrogen, phosphorus, sulphur and selenium? Why?

The following references might prove useful:

1. Bernal, J.D. (1967). *The Origin of Life*. Weidenfeld and Nicolson Press.
2. Calvin, M. (1969). *Chemical Evolution*. Clarendon Press.
3. Sneath, P.H.A. (1970) *Planets and Life*. Thames and Hudson Press.

### Diseases

*Plasmodium falciparum*. It produces the deadly malaria in man, that is often fatal. Laboratory tests have shown that applying oscillating magnetic fields (OMP) reduced the cerebral malarial

parasities by 33-70 per cent. The malarial parasite first invades the liver and then emerges in the blood stream and attacks the red blood cells

- Q 1. Advance your conjectures on how the exposure of the malarial patients' oscillating magnetic fields can reduce incidence of malaria in them.

**Cancer Cell** : Every time a cell divides, its chromosomes, which carry DNA, get a little worn out. The telomeres, caps at the ends of the chromosomes, fray with every division. When they get too frayed, the cell is supposed to die. But in cancer the cells keep on dividing, growing into tumour.

- Q 1. Make hypothesis how it might happen.

The following exercises would be useful for average students to improve their problem-solving abilities.

### Body Fluid

Read the table on page 85 and try to answer the following questions

- Q 1. Why urea, chloride and ammonia are of the same magnitude in normal and diabetic urines?
- Q 2. Why diastase is lowest in normal and diabetic urine?
- Q 3. Why pH is lowest in diabetic urine than in the other three body fluids?
- Q 4. Why glucose level is higher in diabetic urine than in the normal one?

TABLE 1

## Suggested Composition of Some Body Fluids in Human Beings

Parameter	Plasma	CSF	Urine (normal)	Urine (diabetic)
Urea	50 mg/100 cm <sup>3</sup>	50 mg%	2 g/100 cm <sup>3</sup>	2 g/100 cm <sup>3</sup>
Glucose	100 mg%	50 mg%	Nil	500 mg%
Protein	7 g%	50 mg%	Nil	Nil
Chloride	300 mg%	450 mg%	600 mg%	600 mg%
Diastase	100 units%	100 units%	50 units%	50 units%
pH	7.4	7.4	6.0	5.0
Ammonium	Nil	Nil	50 mg%	50 mg%

Q 5. Why protein does not exist in normal as well as in diabetic urine?

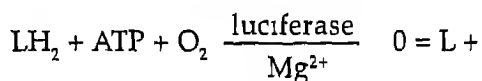
#### Bioluminescence in Living Beings

Many living organisms show bioluminescence phenomenon. Give reasons why the following species make use of it

- (a) Bacteria : *Photobacterium fischeri*  
*photobactrim phosphoreum*
- (b) Fungi : *Armillaria mellea*  
(a wood-rotting fungus)
- (c) Coelentrata *Aqueoria aqueroria*  
(a jelly fish)  
*Renilla emiformi*  
(a sea pansy)
- (d) Crustaceae *Cypridina hilgenreffi* (an ostracod)
- (e) Insects : *Photinus pyralia* (a North American firefly)

(f) Mollusca : *Latia neritoides*  
(a New Zealand limpet)

In general, the reaction is given below:



AMP + PP + H<sub>2</sub> + light is emitted

(luciferin reduced form) O = L pp = inorganic pyrophosphate  
(luciferin-oxidized form)

In *Cypridina* there is no ATP or hydrated magnesium (ii) ions.

How then the process of bioluminescence occurs in them?

The students may like to consult the following materials, after they have answered the questions raised on this activity.

1. Dubois, R C (1983). *Scan. Soc. Bilo.* 37,559
2. Haruey, E.N. (1952) *Bioluminescence*, N.Y Academic Press

3. Mc Capra, F. (1973). *Endeavour*. 117, 32, 139

### Light Absorption by Chlorophyll

Relationship between wavelength and its absorption by chlorophyll is shown below, in Table 2.

Answer the following questions on the basis of the information given in Table 2.

1. Why at wavelength/nm of 455, absorption is maximum?
2. Why at wavelength/nm of 660, absorption is lowest?
3. Why at wavelength/nm of 540, meter reading is maximum?
4. Why at wavelength/nm 465 and 570, the meter readings and absorption rates are almost identical?

The students may consult any standard plant physiology book after they have answered these questions

### Social Behaviour of Bees

The following species of bees have been found to be.

- (a) a solitary bee (*Andrena armata*),
- (b) A social bee (*Bombus terrestris*), and
- (c) an advanced (*Apis mellifera*).

Q 1. What activities would these bees be displaying that have similar characteristics?

Q 2. What activities would these bees be displaying that have dissimilar characteristics?

It is hoped that besides nurturing in the senior secondary students, abilities to think creatively, these activities would as well improve their psychological attributes like independence in thinking and making independent judgements (Torrance, 1962) that are needed for development of tolerance about others' behaviours and living harmoniously as an Indian community. This would

TABLE 2

Relations between Wavelength of Light and Its Absorption by Chlorophyll

Wavelength/nm	Meter reading	Absorption
455	8	92
465	9	91
520	30	70
540	35	65
570	10	81
600	12	88
660	40	60



be positively contributing towards realization of Delors' (1996) dream of living together

*Note:* It is expected that the senior secondary students may respond to these proposed thinking questions

immediately. Let them have their own time to come up with their responses. It is expected that a majority may need quite a lot of reading before they can attempt these questions adequately.

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# Nurturing Creativity through Chemistry

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## Abstract

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*The concept of creativity is a multifaceted phenomenon. There is ample scope for promoting creativity through chemistry, teaching and learning Chemistry is no longer the subject of rote memory. Differences in physical properties like melting point, boiling point, density, solubility, viscosity and similarities and contrasts in many chemical properties of the compounds of the same homologous series can be accounted for by difference in size and shape of molecules and physical factors. The author has suggested how creativity can be nurtured through chemistry curriculum at the senior secondary level.*

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**T**HE word 'creativity' has been derived from the word 'create', which means producing or using new and effective ideas, result etc (Longman, 1995). One who is creative is imaginative. According to Guilford and Hoepfner (1971), divergent thinking abilities are related to creativity Maslow (1970) observes that without fulfilling the basic needs, viz 'physiological, safety, love, affection and belongingness needs and esteem needs for self actualization, the person is sick' Creativity is a pre-requisite for self-actualization Dewey (1910) pointed out that our creative thinking would improve if we relate the new facts with the old ones and all facts with each other Creative thinking occurs when the boundaries of the known are first mastered through convergent processes and then extended by the application of divergent process Lowenfeld and Brittan (1966) have rightly pointed out 'the greatest joy of the teacher and the greatest hope for better world lies in the cultivation of creative power To teach toward creativity is to teach toward the future of society'. Pachaury (1976) investigated into the teachers' perceptions of creative pupils Teachers were found to value curiousness, courageousness in convictions and independence in thinking and judgement in creative children.

Torrance (1970) describes creativity as a process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies,

identifying the difficulty, searching for solutions, making guesses or formulating hypotheses about the deficiencies, testing and retesting these hypotheses and possibly modifying and retesting them, and finally communicating the result Guilford (1967) believes that the degree of creativity shown is directly proportional to the degree of novelty. According to Webster (1977), to create means 'to originate, to bring into existence something new, a work of thought or imagination and creativity means intellectual inventiveness' Newness or uniqueness seems to be a prominent feature of the creative product. Bruner (1962) found newness, surprise and originality in creativity. Jackson and Massick (1965) suggested four criteria to judge the creativity in the product, novelty being the first criterion, others being appropriateness, transformation and condensation.

According to Pachaury (1997), experts on creative personality and Indian scientists share the four common characteristics; they are (i) curious, (ii) courageous in convictions, (iii) dependent in judgements, and (iv) become pre-occupied with tasks. McPherson (1960) collected 26 definitions of creativity and, in an interesting experiment in the fifth Utah Conference, Mednick and Mednick (1964) could get 395 different meanings in response to a stimulus word creativity. MacKinnon (1970) cautions against accepting any single definition of creativity as final. He comments

Definitions of creativity range all the way from the notion that creativity is a simple problem-solving to conceiving it as the full realization and expression of all of an individual's unique potentialities. One would be ill advised to seek to choose from among the several meanings the best single definition of creativity, since creativity properly carries all of these meanings and many more besides. Creativity is indeed, a multifaceted phenomenon.

### Need of Creativity in Chemistry

There is a misconception in the minds of students as well as the teachers that chemistry is a subject that needs only rote memory. One who is good in memorization can do good in chemistry, but it is not the case. Gone are the days when chemistry used to be a subject dealing with methods of preparation of substances and their properties. By laying emphasis on fundamentals like tetravalency of carbon, nomenclature, isomerism, chemical bonding and basics of reaction mechanism, therefore, learning of organic chemistry can be made interesting. Preparation and properties of carbon compounds belonging to different homologous series are interrelated. Differences in physical properties like melting point, boiling point, density, solubility, viscosity, and similarities and contrasts in many chemical properties of compounds of the same homologous series can be accounted for by difference

in size and shape of molecules, physical factors like hindrance, dipole moment, hydrogen bonding and electronic factors like inductive effect, electrometric effect, hyperconjugative effect, resonance etc., but it needs divergent thinking. Electronic configuration of elements and gradation in properties help us in predicting their nature. Many high-order problems have been solved and can be solved by divergent thinking. Determination of structure of benzene obtained by the fractional distillation of coaltar in the middle of nineteenth century was a great problem before the chemists. Molecular formula of benzene was determined as  $C_6H_6$  but it did not fit in any of the homologous series of alkanes, alkenes and alkynes. Well-known chemists of that time, Kekule, Dewar, Armstrong and many others were working only in one direction of open-chain structures. Different permutations and combinations were being tried by them by introducing a few double and triple bonds, but none of the structures of benzene matched with its properties. They were puzzled. Thinking continued and one night, Kekule, on the basis of his intuition, could solve the problem. In 1865, August Kekule offered an answer to the question of structure of benzene: these carbon chains can sometimes be closed to form rings. As he described it later:

"I was sitting writing at my textbook, but the work did not progress, my thoughts were elsewhere. I turned my chair to the fire and dozed. Again the

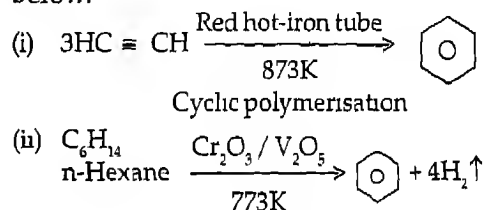
atoms were gamboling before my eyes. This time the smaller groups kept modestly in the background. My mental eye, rendered more acute by repeated visions of this kind, could now distinguish larger structures of manifold conformations, long rows, sometimes more closely fitted together, all twisting and turning in snake-like motion. But look what was that? One of the snakes had seized hold of its own tail, and the form whirled mockingly before my eyes. As if by a flash of lightning, I woke, I spent the rest of the night working out the consequences of hypothesis. Let us learn to dream, gentlemen, and then perhaps we shall learn the truth" (Kekule, 1890; Morrison and Boyd, 1990.) The structure of benzene proposed by Kekule (1865) is valid even today. Hence, let us think divergently to produce something new.

## Creativity in Chemistry

Given below are a few situations/problems at Senior Secondary level, which need high-order of thinking and may help in inculcating creativity.

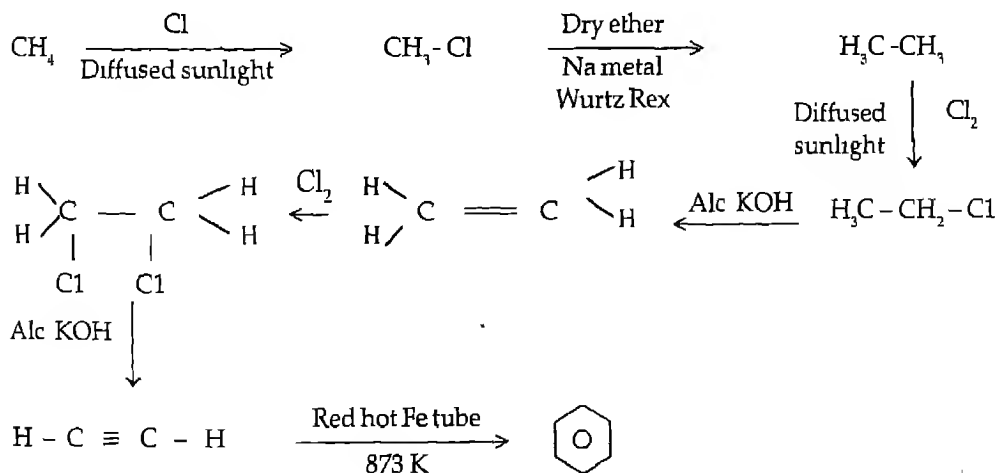
### Synthesis of Benzene from Methane Theoretically

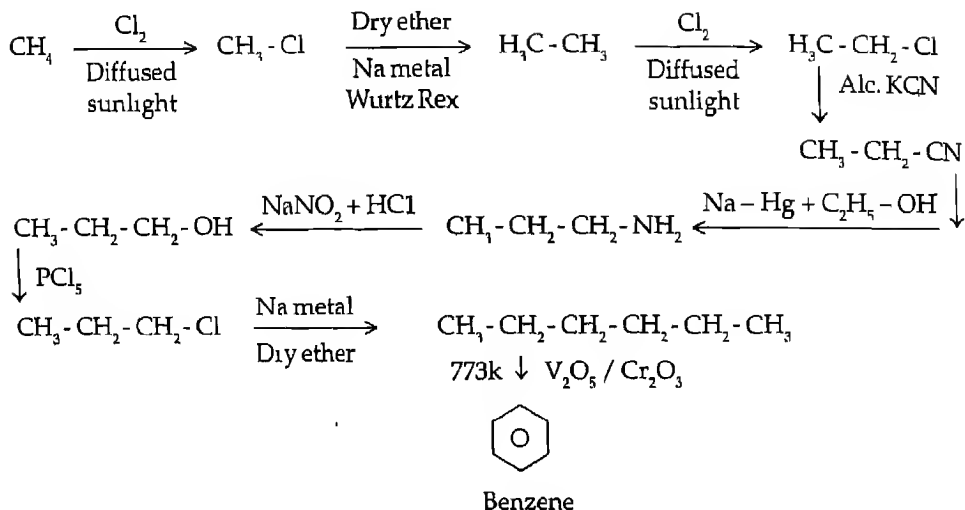
Chemistry textbooks report that benzene can be synthesized either from (i) ethyne or from (ii) n-hexane, as given below.



If we want to synthesize benzene from methane, we will have to think very seriously. If one can convert methane into ethyne or methane into n-

### Solution I



**Solution II**

hexane, the problem can be solved. Solutions of this type of a problem are generally not given in textbooks. Let's try.

The above solutions can be produced only by the learners who have the mastery of the subject and try to think divergently

#### *Conversion of Methane into Benzyl Chloride*

The serious student who knows the subject well may proceed in the manner given in box on page 93.

#### *Arrangement of Acids*

Arrange the following acids in increasing order of their  $P_{K_a}$  values

$\text{HCOOH}$ ,  $\text{CH}_3\text{COOH}$ ,  $\text{C}_6\text{H}_5\text{COOH}$

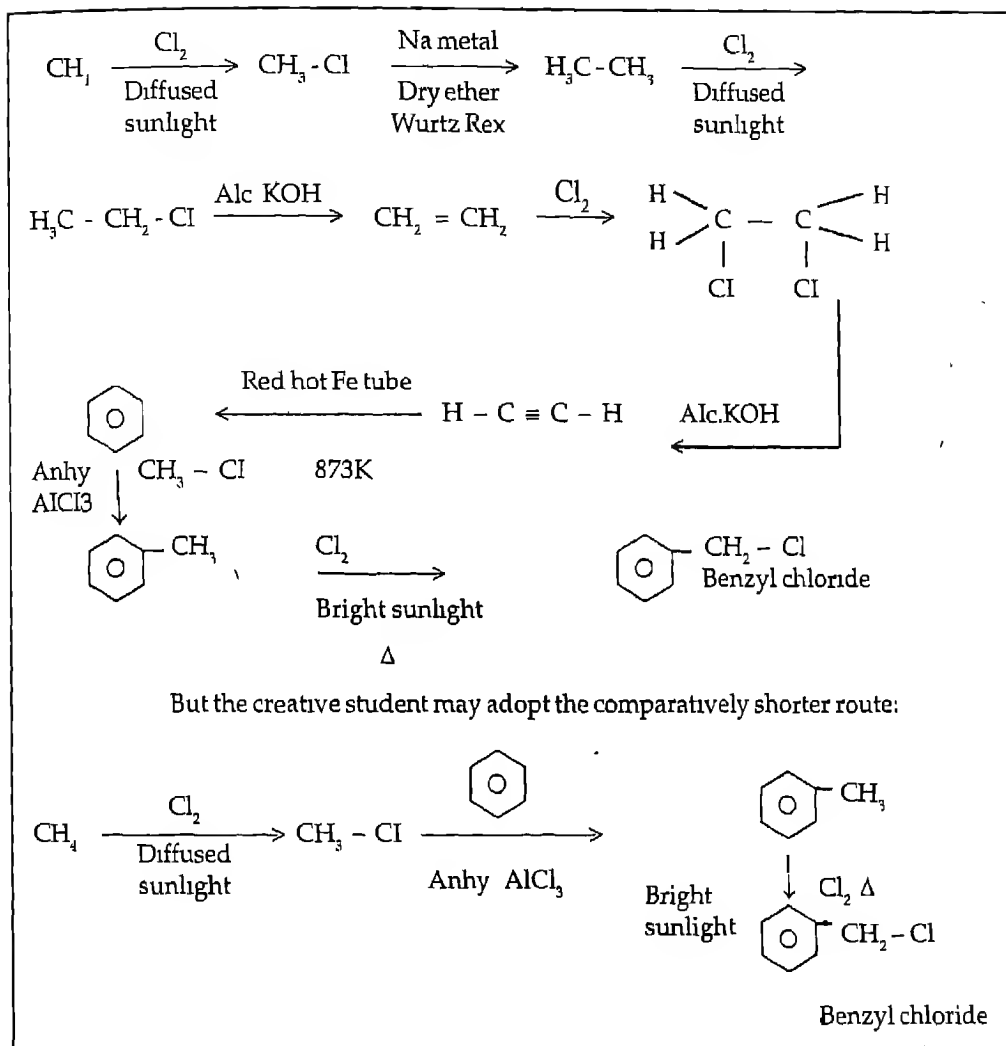
This problem can be solved by brainstorming. It requires the following steps.

- (i) Identification of the strongest and the weakest acids on the basis of electronic effects and steric hindrance.  $\text{HCOOH}$  is the strongest acid and  $\text{CH}_3\text{COOH}$  is the weakest.
- (ii) Idea of  $k_a$  and  $p_{K_a}$  value. Strongest acid has the highest  $k_a$  value but lowest  $p_{K_a}$  value.
- (iii) Arrangement in increasing order: The acid with lowest  $p_{K_a}$  value will be placed on left and the acid with the highest  $p_{K_a}$  value will be placed on right.

Hence the order will be



- |                     |               |
|---------------------|---------------|
| (i) Strongest acid  | Weakest acid  |
| (ii) Max $k_a$      | Min $k_a$     |
| (iii) Min $P_{K_a}$ | Max $P_{K_a}$ |



### Isomers of $\text{C}_4\text{H}_{11}\text{N}$

When the number of isomers of  $\text{C}_4\text{H}_{11}\text{N}$  not producing primary alcohols with nitrous acid are studied,  $\text{C}_4\text{H}_{11}\text{N}$  corresponds to primary, secondary and tertiary amines. Only the primary amines produce primary alcohols on treatment

with nitrous acid. Primary amines contain  $\text{-NH}_2$  group. The isomers not containing primary  $\text{NH}_2$  group will not react with nitrous acid. Structures of different isomers may now be written and the isomers not producing primary alcohols may be identified.

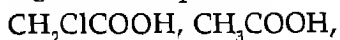
Isomers of  $C_4H_{11}N$ 

- (i)  $CH_3-CH_2-CH_2-CH_2-NH_2$  (Primary amine)
- (ii)  $\begin{array}{c} CH_3-CH-CH_2-CH_3 \\ | \\ NH_2 \end{array}$  (-do-)
- (iii)  $\begin{array}{c} CH_3-CH-CH_2-NH_2 \\ | \\ CH_3 \end{array}$  (-do-)
- (iv)  $\begin{array}{c} CH_3 \\ | \\ CH_3-C-NH_2 \\ | \\ CH_3 \end{array}$  (-do-)
- (v)  $\begin{array}{c} CH_3-N-CH_2-CH_2-CH_3 \\ | \\ H \end{array}$  (Secondary amine)
- (vi)  $\begin{array}{c} CH_3-CH_2-N-CH_2-CH_3 \\ | \\ H \end{array}$  (Secondary amine)
- (vii)  $\begin{array}{c} CH_3-N-CH-CH_3 \\ | \quad | \\ H \quad CH_3 \end{array}$  (Secondary amine)
- (viii)  $\begin{array}{c} CH_3-N-CH_3 \\ | \\ CH_3 \end{array}$  (Tertiary amine)

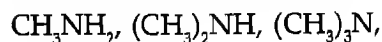
Hence isomers (v), (vi), (vii) and (viii) will not produce primary alcohol with nitrous acid.

Given below are a few problems that may require brainstorming and may help in inculcating creativity.

P1. Arrange the following in decreasing order of pH:

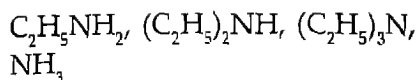


P2. Arrange the following in increasing order of their  $K_b$  values:

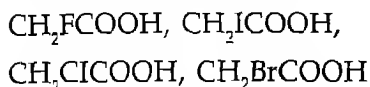


P3. Arrange the following in increasing order of their  $P_{K_a}$  values:





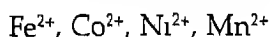
P.4. Arrange the following in decreasing order of their pOH:



P.5 Convert  $\text{CH}_3\text{OH}$  into  $\text{C}_6\text{H}_5\text{NH}_2$

P.6. Convert  $\text{CH}_3\text{COOH}$  into  $\text{C}_6\text{H}_5\text{COOH}$

P.7 Arrange the following in increasing order of their paramagnetic nature.



The above-mentioned problems and problems of this type are rarely being discussed by teachers in the class. Rote memory is being practised. Even in public examinations, we come across many

questions which test knowledge of students (Gupta, 2000). It is therefore suggested that at least 25 per cent of the questions should be of brainstorming type. As a matter of fact, only a few administrators appreciate nurturing of creativity. In classes also, we teachers are interested in finishing the syllabus. For slow learners, teachers should act as motivators, and for gifted students we should act as facilitators of divergent thinking. There should be new challenges for the fast learners. Creativity does not begin at a certain age where new and original solutions to intricate problems are produced, but it is always there inside the creative person. Let us promote creativity in the chemistry classrooms. Let children think divergently.

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# Promoting Creative Problem Solving in Physics

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## *Abstract*

*This paper highlights the role of divergent thinking in promoting creative problem solving in the area of physics. On the basis of Osborn's work, the author has suggested that the learners must possess the competencies of understanding the nature of the problem, comprehend the idea contained in the problem, and should utilize mathematical skills to solve problems. These competencies would not only develop the ability to solve a particular problem but would also strengthen general abilities to solve physics problems.*

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**T**HE general patterns of teaching in physics indicates that teachers narrate or discuss the content/topics included in any chapter, followed by solving a few exercises and then asking the students to solve the exercises given at the end of the chapter themselves. If the students are able to solve a few exercises, teachers provide them the solution. There is no deliberate attempt on the part of the teachers to make the students learn patterns of reasoning and develop the competencies required so as to train them how to think. Students are at best limited to learning, which may include cognitive memory skills such as recalling facts, formulae, procedures and other essential information. In other words, this includes Bloom's knowledge and comprehension level. In a few cases, teachers converge to thinking involving skills such as applying and analyzing information. This is Bloom's application and analysis level. There is a very little or no attempt at all for developing divergent thinking or evaluative thinking, as one particular answer is expected to be any question asked in classroom situation or may be in the examination. Divergent thinking according to Bloom includes the synthesis level signifying the skills of integrating the ideas, constructing and reconstructing the theories, hypothesizing and verifying and so on. It has also been treated by some researchers as interchangeable or synonym to creativity.

## Characteristics of Creative Thinking

Creativity, though considered by some authors as personal idiosyncrasy, is associated with special competencies. If equated to divergent thinking, it indicates the ability to produce multiple, unique and elaborate solutions to problems that can be solved in different ways using the process skills mentioned above. According to Guilford (1975), four abilities, viz. fluency, flexibility, originality and elaboration, characterize creative thinking. Intellectual application for these abilities is divergent and applicable to all content areas.

### *Fluency*

Fluency has three components, viz. ideational, associational and expressional. In context of teaching science, ideational fluency is considered to have been achieved when the learners are able to write titles/words based on scientific principles for the explanation or the details. Also, they should be able to imagine many consequences in case of change in the environment or conditions of life or physical situations, e.g. if the fossil fuels are exhausted. Associational fluency demands the ability to produce relationships using figures, symbols, data, equations, interpretation etc. for the given situations. This in turn requires the ability to synthesize the different ideas under varied situations. Expressional fluency requires the ability to provide connections to

the missing link (s) based on scientific principles to give the full explanation of any event/phenomena

### *Flexibility*

The second aspect pertaining to creative thinking is observable when the learners are able to construct as well as reconstruct their own ideas. They, therefore, exhibit flexibility in their thinking. Flexibility could be spontaneous and also adaptive. In the former, there is a change in the direction of thinking on the part of the learners even without asking them to do so, e.g. the learners having flexibility in idea on being asked about the force, will tend to think in terms of mass, weight, the change in velocity, push, pull and so on. On the other hand, in case of adaptive flexibility, the learners also tend to change the direction of thinking to solve the problems, e.g. how the force is represented mathematically? How does it vary with increase or decrease in mass? When the force is applied, what is going to happen? How much will be the work done and when will it be maximum? and so on. Choice of suitable questions can help in developing this flexibility. These questions have to be at synthesis level, so that these can stimulate children to consider variety, new ideas or original possibilities in an integrated manner for creative problem solving.

### *Originality*

The third aspect showing creativity behaviour is related to the originality of

thoughts, which could be off-beat, unexpected and at times amusing as well. Promotion of such a thinking requires on the part of the teacher that while solving a problem he challenges pupils' questions and answers by telling the learner that he does not understand what he has in mind. He could also argue 'how this question/answer will fit in solving the problem'. If the learner is able to explain the relevance in broader context of the study, argument of the learner can be accepted or else the learner is forced to think his/her argument in some altered context. Such exchanges between teacher and learner held in a proper atmosphere help the learner in understanding that his/her argument is accepted on logical grounds and he/she is neither rejected nor censured without proper reasoning.

### *Elaboration*

The fourth aspect pertaining to creativity behaviour relates to elaboration. Learners having this ability can explain are the major as well as minor details pertaining to subject matter without any doubt.

To cultivate creative problem solving habits so that the learners may develop the above mentioned four abilities, different strategies have been suggested. Significant among them is the one proposed by Osborn (1963). His technique included a five-step process, viz (1) searching a problem taking into consideration different perspectives so that a real challenge and stimulation is there

for finding out the solution; (ii) finding out the facts so as to understand the inherent conditions, situations etc. before making a decision for any plausible solutions, hypothesis etc. (iii) finding out the ideas consciously as well as subconsciously so that the ideas are flushed out before any judgement is taken to attack the problem; (iv) finding out the solution taking into account all the ideas and their relevance and applicability, and (v) finding the acceptance of the solution, which can gain support for its practical use.

### **Competencies Required for Learners**

In order to implement this strategy, the learners must possess certain competencies. An analysis of this strategy was carried out by Jain (1996), as reproduced below

1. *Understanding the nature of the problem*
  - (i) Make appropriate use of the key words given in the problem
  - (ii) Identify the symbols/notations/abbreviations used for physical quantities and their units
  - (iii) Note down the given data/information symbolically
  - (iv) Read the conditions/directions/instructions carefully and understand their implications
  - (v) State the problem correctly
  - (vi) Be ready to solve the problem
2. *Comprehending the ideas contained in the problem*
  - (i) Relate their store of knowledge with the particular problem
  - (ii) Understand the clues/suggestions/hints if given by the teacher/book and associate them with their precious knowledge
  - (iii) Understand the problem formulated in terms/words unfamiliar to them by consulting the references
  - (iv) Formulate questions to break the problem into manageable components
  - (v) Be ready to suggest the line of action
3. *Using the mathematical skills*
  - (i) Deal with mathematical functions such as trigonometric, algebraic, exponential, logarithmic, hyperbolic, inverse trigonometric, inverse hyperbolic and the combination of these functions
  - (ii) Make use of mathematical tables and calculators
  - (iii) Use trigonometric identities, deal with vector quantities and make series expansions/additions such as that of trigonometric functions, algebraic functions, Taylor series, binomial etc.

- (iv) Carry out mathematical processes such as differentiation, integration, finding out maxima and minima etc.
- (v) Draw the graphs
- (vi) Read the graphs
- (vii) Determine the values from the graphs
- (viii) Explain the meaning of the concepts of ratio and inverse ratio quantities, direct proportionality, inverse proportionality etc. and interpret them in words
- (ix) Make approximations.

*Ability to solve problems*

- (i) Analyze the problem into sub-problems, which are more manageable
- (ii) Simplify/reorganize the conditions of the problem(s)
- (iii) Make plausible assumptions
- (iv) Represent situation(s) diagrammatically
- (v) Attempt the solution to problem in a systematic way
- (vi) Idealize the concepts
- (vii) Apply conservation laws
- (viii) Apply symmetry/invariance considerations
- (ix) Recall the values of physical constants
- (x) Isolate dimensionless parameters
- (xi) Transform the given quantities in the same of units

(xii) Write down the appropriate formula(e)

(xiii) Make correct substitution in a formula

(xiv) Synthesize two or more formulae using different concepts and theories

(xv) Calculate the result and express in proper units

(xvi) Interpret the result(s)

5 *Developing general abilities*

(i) See the limitations of a formulae

(ii) Check the validity of any formula by comparing units/dimensions

(iii) Try alternate solutions

(vi) Think for solution in a wide perspective

(v) Adhere to the line of reasoning till the solution is obtained

(vi) Have a positive attitude and confidence

The problem solving skills given above train the learner's minds in problem solving from the very beginning to creative problem solving. Also these skills stimulate imagination when the problems at lower level are dealt with unreal and fantastic imaginary word of point masses, weightless strings, frictionless surfaces and pulleys, ideal gases, perfect bodies and so on. More advanced problems dealing with complicated picture nearer to reality lead to still deeper imagination.

To train the learners in mastering the processes of creative problem solving, the teachers have to adopt certain strategies for curriculum transaction, classroom management and learners' involvement in learning. Parnes et al. (1977) built on Osborn's work suggested techniques for creative problem solving. Taking their principles into consideration, the following strategy is being suggested which has helped the author in bringing out a marked qualitative improvement in past years in creative problem solving. Though no quantitative study has been undertaken in this direction, learners' responses in the classroom have certainly been the indicator.

#### *Building up Confidence*

It is seen that the students at times pick up at a very early stage difficult problems out of sheer enthusiasm than wisdom. Teachers may help by supervising in the selection of the problems. Initially the problems that are relevant and related with the recently learned principles and also based on earlier taught principles may be selected. These should not be stereotype and must possess a variety. Solving such problems builds up confidence in the class as a whole.

#### *Removing Internal Blocks and Mental Brakes to Creativity and Encouraging Freewheeling*

In order to promote creative thinking, management of the class is very important. Problem-solving activities are likely to increase teacher's problems. Teaching

practices that involve group discussion and participation yield results superior to individual problem solving by the learners to achieve better results. Teachers should try to see that each student presents his/her argument freely and in a climate of mutual respect amongst the students and between teacher and students. Students should feel assured that their ideas will not be ridiculed even though these may be extremely off-beat. Teachers should set the stage for more and more brainstorming sessions. Only then the students will feel free to project their new or unusual ideas before others and will keep to themselves. Such a strategy in the long run will prove superior to procedures that concentrate solely on solutions to individual problems without regard to skills.

#### *Keep the Fantasy Alive*

There is a common belief that to fantasize or living in flights of imagination is the indicator of immature thinking. It is not true. Fantasy is a part of human behaviour and a vital ingredient in creativity. Rather it shows adjustment and mental growth. It is, therefore, necessary that if the students communicate some hypothetical ideas or solutions which require ideal or non-plausible situations, they should not be discouraged.

#### *Make Students Aware of Role of Sub-conscious Thinking*

It is a common experience that even when we are not thinking about the



solution to any problem, our minds keep on working at it. Thoughts come and fade away. Students may be better advised to note down all such thoughts so that they can organize them at a later stage with critical thinking. It is worthwhile to mention here that Archimedes' shout 'Eureka' did not come as a part of organized attempt in finding out the solution to his problem. Likewise, apple fall observed by Newton was not a part of his organized attempt to propound the gravitation theory.

#### *Defer Judgement*

Students should be advised to give a final shape to the solution after all the ideas are flushed out and weighed on scientific principles. Even the teachers while solving the problems in the classroom should give sufficient time to think so that even the students whose reaction time is more may respond and participate in the discussion.

#### *Control Direction of Imaginative Thinking*

Though mentioned above that the off-beat, ridiculous, free and loud thinking as well as fantasizing the ideas should be permissible, the students should be made aware of the fact that their ideas are open to scrutiny. Their ideas will be critically examined. Some ideas may get rejected, some accepted and other ones modified. This is how the ideas will be constructed, reconstructed and radically changed after discussion are held on logical grounds.

#### *Make Students Aware of the Role of Metaphor and Analogy*

It is obvious that in order to explain an unfamiliar phenomenon, students make connections with examples and situations about which they know. At times though the teachers give analogies to make the understanding easier, at other time there are student-generated analogies. Teachers' role in this connection is to generate discussion in such a way that the students are able to see the similarities of any idea behind the analogy with the existing problem. At the same time the students should become aware of the limitations of the analogy as the two events are in general not identical.

#### *Increase Knowledge to Develop Problem-solving Skills*

Problems are not solved by chance and without knowledge. Creativity depends upon knowledge previously acquired, assimilated and accommodated. It is therefore necessary that teachers help the students in acquiring new ideas, information and knowledge. However, it should be remembered that though subject content is important, it does not automatically lead to learning experiences. Development of process skill should be the aim of the teacher rather than merely solving a few problems. Dependent upon the nature of the problem, the teachers will have to select and train the students in applying appropriate skills and knowledge to facilitate the

solution of the problems. Teachers should also attempt to develop such usable strategies that lead the learners in solving the problems independently, i.e. in the absence of teacher's guidance. It will require training the students in various skills through a variety of problems. Rigidity, i.e. there is only a unique way for solving the problem, is to be discouraged. Besides, teachers have to emphasize that the end result is of value. Rather more important is the process of reaching at the correct answer. Thus learning to think in a variety of ways and thereby solving the problems by using the acquired knowledge should be an integrated process and form an essential part of school science to develop creative problem-solving behaviour.

#### *Reinforcing Problem-solving Skills is Worth Developing Creative Thinking*

Problem solving has to be taken seriously with a positive attitude by the teachers and the learners and not to be seen merely fun and games. Students should get a feeling out of teacher's activities that gains in skills are worth spending time and effort for their enrichment in developing creative thinking.

#### *Asking Open-ended Questions*

Questions asked from students are indicators of the direction of thinking. Asking open-ended questions that encourage a wide range of answers with-

out concern for a single correct answer help in developing creative problem-solving. The technique helps students to think independently from different angles. Various responses obtained without giving or giving a very little structure or prior information encourage other students to combine original and known ideas into new ideas or explanations.

#### *Reversing the Line of Thinking*

A study undertaken by Jain in 1999 in connection with interpretation of physical quantities indicated that the development of concept of reversibility amongst students is very minimal (4%). It retards divergent thinking required for creative problem-solving. However, the techniques of (i) idea first and name afterwards, (ii) asking or verbal interpretations of ratio quantities, and (iii) using graphical interpretations, have proven to be useful in developing the concepts in my further regular course of teaching, as students are seen at ease to elaborate the ideas that are a necessary component of creative thinking.

Finally, it may be concluded that creative problem-solving is not a method of teaching. It is a general attitude that encompasses several process skills aimed at developing divergent thinking. Teachers' role is to facilitate the same so that amalgamation of original and known ideas leads to new ideas or explanations.

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- "Problem-solving is a complex, multi-layered skill" (Hafner and Stewart, 1995) The process part of problem-solving depends on, (a) fluidity of thinking (Guilford, 1986), (b) generation of mental elements (Johnson-Laird, 1993), and (c) the continuous search for new ideas The creativity required to solve a problem is an individual activity that depends on (a) conceptual clarity; (b) general and domain specific problem-solving heuristics; and (c) insights into the nature of that discipline as an intellectual activity Below are given some recent works for the benefit of the teachers/educators – Guest Editor
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# Curricular Approaches for Training in Creativity

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## Abstract

*Researches conducted during the past four decades have shown that creativity can be fostered. While the earlier approaches were focused on conceptualization, identification and assessment of creative talent, the emphasis has gradually shifted to curricular approaches. As a result there is re-orientation in the study of creative talent. This paper describes the different curricular approaches with examples from school subjects. Along with this there is description of the emerging trends such as use of training, critical thinking, creative combination of random objects, words and use of newspaper items consisting of classifieds, comics, arts and fashion sections.*

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**C**REATIVITY has been defined in different ways and with different orientations, such as philosophical, psychological, statistical and educational aspects. Creativity is also perceived as a process and product. In literature different words or phrases have been used for characterising a creative person. A creative person is viewed as ingenious, inventive, imaginative, having the power to produce things, able to compose with words, music and also be able to design with materials. Also, creative thinking is considered to be a highly particularised and substantive capacity. It is a rare and unique manifestation of talent in a particular field. According to Ausubel (1968), "It is general constellation of supportive intellectual abilities, personality variables and problem-solving traits". Creativity is also defined in terms of personality factors and problem-solving capacities. According to Torrance et al. (1960), "It is the process of sensing gaps or disturbing or missing elements, furnishing ideas or hypotheses concerning them, testing these hypotheses and communicating the results, possible modifying and retesting the hypotheses".

Creative thinking is a form of problem-solving, which involves intuitive jumps, or a combination of ideas from widely separated fields of knowledge (Gagne, 1965). In the beginning of the creativity movement we relied upon the approaches adopted by the explanation-minded psychologists on the one hand

and the application-oriented educators and business people on the other. Among the psychologists, Kohler's studies on chimpanzees, children and chickens are important. British psychologists, like Vernon (1973) viewed creativity as a part of Thurston's eight primary mental abilities, i.e. word fluency (W). These approaches were followed by practical activities that aimed at enhancing creativity. Earlier studies on problem-solving demonstrated the Gestalt concept of "insight" or "cognitive restructuring".

### **Rationale for Curricular Approaches**

Different studies (Osborn, 1957, Parnes and Meadow, 1959, 1969, Sullivan and Taylor, 1967; Maltzman et al 1958, 1960) have shown that creative abilities of the individuals can be enhanced. For classroom activities, creativity principles were demonstrated effectively by Dewey's (1933) description of "How We Think" and Shulman's (1965, 1967) concept of inquiry training. However, Davis (1973) in his book reminded us that "problems in the real world are not neatly or clearly defined and presented to the individual as these are in the experimental laboratory, nor is the point of solution always clear. Rather the human encounter involves sensing the problem, a disequilibrium experience; formulating the problem; searching for relevant information, and resolving the felt difficulty to the individual's personal satisfaction". Torrance (1962), a pioneer in creativity, investigated the strategies

of fostering it. He suggested that creative abilities can be enhanced if appropriate supportive behaviours and classroom practices are evolved and tried.

Lazarowitz and Huppert (1980), in their study, aimed at developing creative thinking in the secondary school biology students. They exposed 20 students of experimental groups to a problem. In a certain town, a serious intestinal disease erupted. People knew that the cause of this disease was a bacterium. Suggest as many ways as possible to protect against this disease. The other problem was, Suggest hypotheses describing the properties you think colour should have to stain living cells in the most effective way so that they can be examined under a light microscope. There were 19 students in the control group and they followed traditional teaching. After two weeks, another problem was posed to both the groups. The problem was, "Suppose you are working in a drug factory and you receive a research grant for developing an effective medicine against a specific disease. What data would you look for before you start to carry out scientific experiments for developing such a medicine?" In this problem, students were asked to give maximum number of responses they could give in 30 minutes' time. Responses in the experimental group ranged between 0 and 29, with a mean of 9.55, and that of control group ranged between 0 and 18, with a mean of 5.15 responses. Responses were classified under 23 major ideas. Mean flex-

ibility score of the experimental group was 3.95 and of the control group 2.70. Further, for originality component, it was 8 in experimental group and 1 in control group. It is evident from the study that short treatment of two lessons produced difference in fluency and flexibility scores of the students.

Hypothesis-making and hypothesis-testing stages have been viewed by other researchers (Dewey, 1933, Gregory, 1961, Shulman, 1965, 1967) as important phases of creative problem-solving process. These two phases were termed by Gregory (1961) as, (i) expository, hypothesis-developing research, and (ii) confirmatory, hypothesis-testing research. The author, in her doctoral level work, made a study of hypotheses-making (HMA) and hypotheses-testing abilities (HTA) and later on determined the inter-relationships with the variables of school achievement, intelligence and socio-economic status. The items used for assessing HMA and HTA of the students were open-ended divergent production type questions, like the following:

- (i) You have grown pea plants in a field. Their growth stops suddenly. What might be the possible causes?
- (ii) What will happen to the biology laboratory work if the frogs start understanding the language of human beings?
- (iii) Suppose oxygen and hydrogen of water start decomposing, what will happen?

Analysis of responses reflected that there was variety in their responses and they went beyond their textbooks. For example, in response to item No.1 of a HMA test, some 40 replies were given by the students. These were classified into 6 categories, which indicated flexibility in their responses. The identified categories were: (i) lack of essential conditions for germination; (ii) variety of seeds; (iii) physiological causes; (iv) effects of pesticides etc., (v) climatic effects, and (vi) parasites and other interfering agents.

How often do the teachers put such questions or give to their students the chance to ask such questions? In the following section are presented developments in curricular approaches for training in creativity.

### Developments in Curricular Approaches for Training in Creativity

Review of literature on curricular approaches for training in creativity indicates that several trends have emerged over years. These can be grouped under the following heads:

1. Earlier approaches for the conceptualization and measurement of creativity among school children.
2. Selected innovative education projects and programmes for the promotion of creative talent.
3. Methods and techniques devised through inter-disciplinary research.

### Earlier Approaches

Davis (1973) has identified approaches which had a focus on training for creativity education. These include: Dewey's Reflective Thinking; Inquiry Learning; Brainstorming; Strategies for Stimulating Solutions to Problems; Metaphorical Thinking and Problem-solving; Syntectics; Bionics and Imaginative Problem-solving in Classroom. A brief treatment of these approaches along with their relevance in education is presented below.

#### *Dewey's Reflective Thinking Approach.*

Most educational writers have defined inquiry in terms of the processes, such as hypotheses-making and hypotheses-testing, to find solutions to the uncertainty. Dewey (1933) conceptualized inquiry as "reflective and critical thinking" and has categorized it into five phases.

- (i) Mind leaping forward into a possible solution,
- (ii) Felt difficulty transformed into a problem, a question for which the answer must be sought,
- (iii) Use of one suggestion after another as a leading hypothesis,
- (iv) The mental elaboration of an idea through reasoning; and
- (v) Testing the hypotheses by imaginative action. Dewey's reflective thinking, carried out through phases, was followed by many researchers, each one giving one's own



elaboration to the creative process, such as thinking as a 'purposeful and directed thought'.

*Suchman and Bruner on Creativity as Inquiry Learning.* Suchman (1966). and Bruner (1966) have viewed creativity as a process of inquiry and discovery learning. Suchman described inquiry as 'learning that is meaningful and intrinsically rewarding to the learner. He suggested that students may be prescribed a discrepant event. It may be through demonstration of an event by showing a film or by drawing lines; curiosity has to be aroused in the students' minds. They may be asked to frame questions in such a form that these can be answered by the teacher in 'Yes' or 'No' form. Suchman's is an episode-analysis strategy, which develops in the students ability to ask pointed questions. The 'ring and ball' example given here is used to illustrate the strategy. "A heated metal ball does not pass through a ring whereas the same ball when cooled passes through the ring easily" The students came forward and asked questions as given below

Student : Were the ball and ring at room temperature to begin with?

Teacher : Yes

Student : After the ball was held over fire it did not go through the ring

Teacher : Yes

Student : If the ring had been heated instead of the

ball, would the result be the same?

Teacher : No

Student : If both had been heated would the ball go through?

Teacher : Depends

Student : If both were heated to the same temperature, would the ball go through?

Teacher : Yes.

Student : Would the ball be of same size after it is heated?

Teacher : No.

The above questions were for information-gathering and hypotheses-testing purposes and also to enable the learners in studying the properties of certain objects, systems and cause-effect relationship. Such exercises help the learners to think divergently and formulate questions that ultimately help problem solving.

Bruner et al. (1966) have given the characteristics of a student who is oriented towards discovery learning:

- He is intellectually more effective and expects that there is something to be found out. This expectation motivates the search, and the learner persists in the search for relatedness. Thinking exhibits connectedness, questions are cycled and recycled, as given in the above example.

- He is governed by intrinsic motivation and is heuristically inclined. The individual makes discovery by practising problem-solving. Problem-solving skills improve through repeated experiences with inquiry.
- The learner preserves information into a personal cognitive structure, thereby maximizing its retrieval in future.

In discovery learning, the individual learner uses one's own intellect to gain knowledge by discovery and organizing concepts that are personally meaningful. Implication of Bruner's work for creativity is that the children may be exposed to a large number of stimuli so that they can reorganize them cognitively and use in creative problem-solving. Bruner (1957) has described the significance of man's ability to go beyond the information given. According to him, problem-solving becomes easier whenever an unfamiliar problem can be identified as a member of the type of problems whose solution-strategy is already known. The students in Pythagorean theorem easily find the solution of new right triangles. An important implication for teaching transferable skills is that we should emphasize what is generic about a given problem, so that new related problem may be handled more creatively. For example, in the teaching of the Periodic Table of elements, there are very large number of reliable productions concerning properties of chemical compound

*Osborn on Brainstorming*. In 1963, Osborn discussed about imagination as a training exercise for the children or professionals to generate ideas for creative problem-solving through brainstorming sessions. He believed that it is possible, through this technique, to allow a free flow of the unconscious. The method resembles psycho analysis in the sense that the student is helped to detach his/her thinking from critical restraint and allows as free flow ideas as is possible. Students in the classroom may be exposed to brainstorming sessions for problems such as:

- Problem I · In your house the number of cockroaches has increased enormously. What measures would you suggest to stop this menace?
- Problem II · In how many ways can you improve the black-board of your class?
- Problem III · How were the forts and temples built on high altitudes with heavy materials?

It is reported by Osborn that about 121 ideas generated in an industry through brainstorming led to a saving of 12,666 manhours in a period of 9 weeks. There are four ground rules that are followed in a brainstorming session

- Criticism is ruled out
- Free wheeling of ideas is welcomed
- Quantity is wanted

- Combination and improvement are sought

These principles are the components of the ground principle of 'deferred judgement'. Perhaps the most pertinent thing that can be learnt from brainstorming is the creative atmosphere of the classroom, where the teacher recognizes that the 'wild thought' might be tamed into a workable solution or might stimulate others to create further ideas. Combination and modification of earlier ideas to the production of new ideas. Davis (1973) concluded that brainstorming is 'more creatively productive than an average committee meeting'.

#### *Stimulating Creative Solutions*

It involves two techniques. (i) Attribute listing. Instruction in the use of these two techniques was incorporated in most of the professional training course in business and later on adapted to education. Attribute listing was first introduced by Crawford (1954), who took the position that original invention on any field can be made by improving the attributes (parts, qualities, characteristics etc.) of objects in any field—literary, musical, pedagogical, artistic objects etc. For example, a common piece of chalk has attributes of size, colour, shape and hardness. The teachers teaching science and vocational subjects can invite suggestions from the students where attributes of teaching aids, equipments and materials commonly used in the class can be changed. A study by Warren and Davis (1969) showed that this

technique can stimulate creativity of older children. (ii) Idea check-list. As the name indicates, idea check-list amounts to examining some kind of "task" that could suggest solutions for a given problem. A creative idea is the one that can result in some new combinations of previously unrelated ideas. An idea check-list essentially stimulates non-obvious and non-conventional idea combinations. Common examples are: How can we reshape a mouse trap, can-opener and other objects of daily use? How can we reduce the incidence of thefts? Ideas rated above the mid-point, on a seven-point creativity scale, by each of the two judges were considered "creative". Davis and Houtman (1968), in their creative problem-solving programme, taught the sixth to eighth grade students some effective strategies for designing, inventing and improving physical products. They gave seven possible hints and suggestions. These were: change colour, make new size; change shape; introduce new material; add or subtract something, rearrange, and introduce new design. Students were encouraged to make objective evaluation of their own thinking. It is observed that the students who make evaluation of their own thinking are less likely to be inhibited in future functioning.

*Using Synectics*: Gordon (1961) is the originator of 'synectics' movement. The term 'synectics' is taken from the Greek term *synektos*. It means joining together clearly unrelated items. For example,

the wings of insects and birds are analogous organs, whose functions are similar but evolutionary origins are completely different (It means they are not homologous organs). A strategy, based on analogies, is used for developing creativity. It requires generation of ideas by connecting a familiar content to a new or looking at a familiar content from a new perspective. The uses of three types of analogies by Gordon-Direct, Personal and Fantasy—are illustrated below for fostering creativity among the learners.

*Direct analogy* : For problem-solving the individuals begin looking for remote problem parallels, especially from natural biological systems such as how animals, birds, insects, flowers and trees adapt themselves to different conditions. This means that they see direct analogies for their problem-solution. In classroom the teacher can give an example of chameleon who changes its colour for camouflaging itself as the need may be. Recently there was a mention of problem of stitching weather-related uniforms for the Indian soldiers serving at high altitudes. We need uniform material for the army personnel, which may change colour according to local climatic conditions. Answer to this problem will perhaps come from direct analogy.

*Personal analogy* . To enable the students to get insight into the mechanics of a car, they may be asked to list the connections they see between a 'car' and a 'bird'. The bird has brain, eats food, has nervous

system and falls sick. The car has an engine, consumes fuel, has mechanical connectors and breaks down. After this, the students may write down a short paragraph indicating the analogical connectors.

*Fantasy analogy* : It is based upon Freudian concept of wish fulfilment. Examples are. How can a refrigerator defrost itself? How can the tyres repair their own leaks? John Foster in his book, *Teacher and Creativity*, suggests that the language teachers may ask their students to write paragraphs on topics like: "The refrigerator that ate food", "A cat that runs backward" and "A dog that does not bark"; and "A girl who wants to be a football player".

*Bionics Principles* . Bionics has been defined as "the use of biological prototypes for the design of man-made system" (Papanek, 1969). In this approach, the bionics make a study of the structure, functions and mechanics of plants and animals to obtain information of design which is similar to the man-made systems. It is a kind of problem-solving strategy, which resembles with the direct analogy method of synectics. For example, the aeronautical engineers studied the manner how the vultures become air-borne after running on the ground for some distance and also their mode of landing on the ground. Then they designed the take-off and landing mechanisms of aircrafts to ensure maximum safety during take-offs as well as landings. In order to develop biology-

based innovative engineering designs, the engineers study closely the motor, circularity, neural and sensory capacities of organisms (mammals, birds, reptiles, fish and insects) Today, we see a variety of toys for children that have been made on bionics approach Children may be encouraged to take up small project where they are asked to describe the improved designs of toys that interest them the most

#### *Selected Innovative Educational Projects and Programmes*

There are several content areas in psychology, education and psychometry that have a direct bearing on the teachers' training programmes from the viewpoint of creativity The relevant components of such projects, which have been undertaken, need to be included in the pre-service and in-service education and training of teachers These could broadly include the study of the following projects

1. *Significant Research Studies on Gifted and Creative Children* Terman's (1954) study of Genius-Discovery and Encouragement of Exceptional Talent, and Getzels and Jackson's (1962) study of Creativity and Intelligence
2. Roe's (1951) study of Eminent Scientists.
3. Bloom's (1956) Taxonomy of Educational Objectives and subsequent work on this model, especially for analysis and synthesis objectives
4. Guilford's (1967) Structure of Intellect Model and other studies, especially on divergent productions.
5. Studies by Torrance (1962) on the Measurement of Creative Thinking.
6. Studies on Critical Thinking Abilities, undertaken by Kaplan (1964) and Arons (1985)
7. *Specific Programmes Conducted by Education Departments* : In Canada, Alberta's Education Services developed a programme 1966 for the use by the teachers in the education of gifted and talented children Learning Resources Centre of Alberta's Education Department is the contact point for the dissemination of these materials.

These studies, projects, programmes and services are only selected examples. Many more such methods, materials and techniques have been developed for the development of creativity among different target groups, especially for the schools

#### *Methods and Techniques Devised through Inter-disciplinary Research*

Several new methods and techniques, developed in other disciplines, have implications for teaching.

*Two Categories of Creative Persons* : Generation of ideas and creative solutions has been the concern of modern creativity educators. The life-histories and how the creative geniuses have made

their marks in life have also been the subject of study. Michalko (1998) has provided insight into the thinking strategies of about 30 creative giants from the fields of science, arts and industry. Among others he included Einstein, Darwin, Picasso, Aristotle, Disney, Eliot, Newton, Russell and others. For years, the scholars and researchers have tried to draw lessons and generalizations from the vital statistics, as if piles of data (i.e. age of the creative persons, childhood experiences, IQ level, achievement level etc.) would somehow provide a link between these factors and creative genius. But no firm research conclusions can be drawn with regard to the childhood background of the creative thinkers. There are more contradictions than agreements in this regard. There are two types of persons, one category consists of those who think 'reproductively' and depend upon recall, and in the second category are the creative persons, who think 'productively' enough. Many persons of average intelligence can give unconventional response to a problem. According to Michalko (1998), they tend to think reproductively depending upon their past experiences. They ask themselves, "What have I been taught in my life, education or work that will solve the problem?" Michalko has identified nine categories in all, divided in two main parts, on the basis of his own analysis of the creative persons. In part I he deals with those "*seeing what no one else*

*is seeing*". This part consists of two sub-strategies, (i) *knowing how to see*, and (ii) *making your thought visible*. One of the most important conclusions is that the creative geniuses do not approach problems reproductively on the basis of past experiences as it will lead them astray. On the other hand, they reconceptualize the problem. The other conclusion is that a creative person, like Einstein, had a very visual mind and he thought in terms of spatial forms, rather than thinking along purely with mathematical or verbal line of reasoning. In Part II Michalko's theme is "*Thinking what no one else is thinking*". In this part, he has suggested seven strategies.

- (i) thinking fluently,
- (ii) making novel combinations,
- (iii) connecting the unconnected,
- (iv) looking in the other world;
- (v) finding what you are not looking for; and
- (vi) awakening the collaborative spirit

*Creative Combining of Random Objects*: It can be an interesting exercise for developing creativity in the children. Suppose you have taken children for an educational trip to Manav Sanghralaya (Museum of Man) or some other local museum. Practical exercises to be done by the students during field visits would be.

- (i) Ask the children to list objects or things that interest them most
- (ii) Ask them to select the first object and describe what comes to their

- mind about it. They may write just a word or phrase about it.
- (iii) They study the object and list all of its descriptive characteristics (specific parts, relationship, what it does, its essence etc.)
  - (iv) They may examine each characteristic and use it as a stimulus for suggesting ideas by establishing connections between the characteristics.
  - (v) They may continue the process with all the characteristics of the object.
  - (vi) They may test different ways to connect characteristics.
  - (vii) They may select second object from the list and repeat the process.

Newspaper sections consisting of Classifieds, Sports, Comics, Arts and Fashion can be used for different problem solutions. Some more examples are.

- (viii) Listing combinations of key-words from a given list (e.g. electronic networks, universities/industry, print, internet, information resources and information services)
- (ix) Combining the unrelated items

*Use of Random Words* : Michalko (1998) has given a list of random words on the pattern of random numbers. Each set of words consists of a five-word item (e.g. ladder, bus, toy, hair, rubber-band). An item from these sets of five words can

be drawn randomly from the main list. Then these words can be connected to each other in order to produce a creative meaningful link. Teachers can draw a list of words from a textbook or a dictionary, and study students' responses for creative connections. Appropriate scoring procedure is worked out on the pattern of scoring the creativity tests.

Michalko has concluded that creative geniuses are genius because they know "how" to think instead of "what" to think. Creativity materials have been developed mostly for use in business and industry. For adaptation to Education, we need to draw the attention of teacher-educators so that work-books may be developed and introduced into our teacher-education system, especially in the DIETs. Application of thinking strategies has to form a part of teachers' initial training and subsequent in-service programmes as well.

In conclusion, it may be stated that this paper has dealt with a multiplicity of strategies and materials for the development of creative talent of the learner. Some of these have been supported with examples. With the availability of media and a large number of teaching-learning materials, it should be possible for the teachers to use the best ideas for the promotion of creative talent of the learners.

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# Promoting Fluency among Blind Children

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## Abstract

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*Blind children are not disabled, they are differently abled. We have to make them receptive to messages through various senses and help them to develop sensitivity and selectivity. They can be helped in this process by story telling, listening to poems and literary activities that appeal to the senses, particularly listening and touch. The focus here has been to foster in them a desire to express themselves so that they can communicate with peers and teachers with fluency. Guilford's "three dimension model of intellect" explains that people may use their intellect in a number of different ways to process information received from the environment. Cognition and memory play an important role in promoting fluency among blind children. He suggests eight creative thinking abilities viz. ideational fluency, associational fluency, spontaneous flexibility, adaptive flexibility, originality, elaboration, sensitivity and curiosity*

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**P**EOPLE who recognize the importance of seeing only in concept learning are not aware of the role of the other senses in developing child's creative abilities. It is essential to help blind children develop all other senses. They must be given opportunities to listen and sense the facial vision, smell things, taste things and see things through actual exploration. Children's senses are actually developed. Our job as a teacher and parent is to keep them receptive to the messages from their senses and help them to develop 'sensitivity and selectivity'. They need opportunities to let their imaginations reach out and explore things for themselves. They should be able to follow where their imaginations take them. They can be helped in this process by story telling, listening to poems and literary activities that appeal to the senses, particularly, listening and touch. The focus here should be to foster in them a desire to express themselves so that they can communicate with peers, parents and teachers. Children should be helped from the very beginning to notice that there are times when they use all five senses whereas at other times, only one or two may be important. In *About Four Seasons and Five Senses*, Radlauer (1963) concentrates his attention through rhyme on the five senses of seeing, hearing, smelling, tasting and feeling by touch. The main objective in working with the senses is to help children become imaginative viewers, who are able

to see things differently and freshly. Most of the children initially begin by noticing everything but, as they grow older and have more to compete for their attention, they fall into grown habit of "looking without seeing".

Guilford's (1960) three-dimensional model of intellect explains that people may use their intellect in a number of different ways to process information received from the environment. This model involves knowing or understanding items of information (cognition). The model's second facet deals with four kinds of information viz. figural, symbolic, semantic and behavioural. Figural content deals with things that can be seen, heard or touched or recalled as images or mental pictures (Khatena, 1978).

In a blind child much more hearing and actual opportunities are to be provided for handling the five mental operations viz. cognition, memory, convergent thinking, divergent thinking and evaluation. The first two components of operations—cognition and memory—play an important role in promoting fluency among the blind children.

In regular class teaching, other emphasis has been laid on visual and hearing activities. For promoting fluency among blind children, more and more emphasis should be laid on teaching-learning through tactual and hearing activities. Guilford (1959), suggested eight creative thinking abilities, viz. Ideational fluency, Associational fluency, Spontaneous flexibility, Adaptive flexibil-

ity, Originality, Elaboration, Sensitivity, Curiosity.

Fluency of ideas or, as Guilford calls it, 'ideational fluency', is an important part of any creative process. The specially gifted individual has it to a higher degree than is usually found in normal every child. In early childhood this fluency of imagination deals mainly with continuously developing responses toward subject matter and flexible use of concept called schemas. What is that distinguishes a gifted child from the average child? Lownfeld (1957) considers that five factors stand out among the many to be considered:

1. Fluency of imagination and expression;
2. A highly developed sensitivity (movement and space);
3. The intuitive quality of imagination,
4. Directness of expression, and
5. The high degree of self-identification with subject matter and medium.

Ideational fluency involves the production of many ideas where free expression is encouraged and quality is not evaluated (Torrance, 1965). This ability can be assessed by asking questions, 'like give as many ideas as you can', for the improvement of a product or 'suggest new uses of the product'. Expression of one idea often stimulates other ideas, may be of better quality. Ideational fluency can be promoted by using the following methods

- Through "props" and "starters" What would happen if we add/subtract something?
- Through competitive role playing
- Through group method (brainstorming)

Associational fluency involves the production of words or ideas from a restricted area of meaning. A simple test item would require a subject to suggest several words as synonyms or antonyms for a specific word. Crosby (1954) describes the following ways of having fun with words which may be expected to develop associational fluency:

- Recognize word relationship,
- Recognize words of similar meaning;
- Recognize words of opposite meaning;
- Extend word meanings,
- Select appropriate definitions;
- Detect relevant words, and
- Select words with precise meanings.

Besides, word play or activity involving invention of new words can be useful to develop associational fluency. Children may be asked to make the words that communicate certain feelings or moods. They can be encouraged to make words for ideas, objects, collection of objects and the like.

To enhance children's imagination, curiosity and ideational and associational fluency, wooden or plastic geometrical shaped puzzles with

other shapes enclosed may be given, and they may be asked to figure out, how many squares and triangles are there. Following other activities related to wooden shaped riddles are also suggested to teach the concept of triangle, rectangle and circle, e.g. 'I have three sides and three corners, what am I?' After assuring that the child has developed the concepts of a triangle, rectangle and circle etc., some riddles may be asked for developing fluency and encouraging them to tell as many answers of a question as one can.

- I look like circle. Who am I?
- I look like a rectangle. Who am I?

For promoting creativity among the blind children, multi-sensory approach is now being envisaged so that even, remaining vision may also be utilized along with the perception of other senses.

### Effects of Blindness on Cognitive Function of Children

The following considerations have to be made while dealing with children having visual impairment.

- Promoting positive self-concept of pupils.
- Emphasis on concept learning through remaining senses
- Open-ended assignment
- Highlighting success stories of blind people activities

- Involving pupils in planning and performing activities.

Blindness imposes some basic limitations upon the cognitive functions of the children.

*Limitations in the ability to get about* The totally blind person is severely handicapped in his/her mobility. Even a small amount of sight skilfully used makes a marked difference in the ability to guide himself/herself through familiar and unfamiliar territory.

*Limitations in the range of variety of experiences:* Blind children build up their conception of word exclusively upon actual, auditory, smell and taste senses. Although hearing gives certain clues in regard to distance and directions, it does not convey and concrete ideas of objects such as shape, size and other physical characteristics. For this purpose actual and kinesthetic experiences have to be provided. Blind children cannot be given the following experiences.

- (i) Experience of telescopic objects;
- (ii) Fragile or tender objects such as spider webs or soap bubbles,
- (iii) Microscopic experience, and
- (iv) Colour perception.

*Limitations in the control and manipulation of the environment and self relation to it:* From infancy onward a blind child cannot acquire behaviour patterns on the basis of visual limitation. Visual experiences have therefore an "object qual-

ity", which permits a contact with and control of the environment for greater than achieved by the other senses. The detachment from the physical environment affects the blind individual in different ways during the developmental period. To reduce this effect and cope with the consequences of blindness, "Curriculum plus skills" have been envisaged to blind children. These skills include sensory training, orientation mobility, abacus learning, braille reading and writing

Knowledge is not only acquired through observation but also communicated through language. The ability to communicate by language is the most important factor in social contact. Blindness does not seriously interfere with language activities.

### **Promoting Ideational and Associational Fluency**

Young children are uninhibited in their exploration of the world through their senses. Too often, growing up is process of learning to shut out these sense impressions that are not immediately important or useful. Encouraging child to make conscious use of their senses (tactual, learning, smell and taste) in exploring the world around them and entering imaginatively into stories and poems will enrich their lives, as well as their own creative expression. This paper is restricted to fluency among blind children. Fluency seems to be the prerequisite of flexibility and originality. Among

the blind children it can be developed through sensitization activities and multi-sensory approach of teaching

### *Fluency through Tactual Activities*

The information we get from hearing and seeing may be abstract and generalized, such as when we listen to a lecture or read non-fiction. But the message we get from other senses like touch, smell and taste are always direct, immediate and personal. It is through tactual senses that blind children form most of their impressions about the physical quality of the world around them. Special education teacher while teaching the blind children should encourage them to ask their faces feel, how the carpet feels and what are your favourite things to touch. For promoting fluency through tactual activities, teachers should provide objects of different sizes and textures to the children to feel while talking about the sense of touch. As youngsters gain some experience in describing the way they feel things one might try to provide a variety of textures such as sand paper, silk, leather and velvet for children to describe. To conduct a discussion on physical feeling into being and to arouse an abundance of ideas and to incite each child's associational fluency, the teacher may make use of related poems like "Hands and Feet" written by Aldis. The poem enumerates only the thing that hands or feet can do. Through such poems and related activities children will certainly be stimulated to try their own creations

on what hands and feet can do. This approach is effective in promoting ideational and associational fluency of the children. Similarly, Alike's book *My Hands* refers to all wonderful things that hands can do. Teachers might ask whether hands could indicate that they liked or disliked someone very much.

#### *Fluency through Hearing Activities*

The sense of hearing plays an important role for a blind child in exploring the surroundings with confidence. Listening helps them follow teacher's instructions in the classroom. Listening also helps the blind children for developing good orientation and mobility skills, which are essential for their daily living. The child not only has to be able to pick out main ideas, but also ignore distracting noises, identify activities by their sounds and be able to locate the position of an object or person by their sounds. Some listening skills, like picking out main ideas in a story being read are difficult to learn and take time and practice to master. Development of these skills should begin as early as possible. A child should be able to-

- Be aware of sounds (I hear something)
- Identify sound (what is that sound?)
- Select one sound from many different sounds (what is that one sound?)
- Localize sounds (where the sound comes from?)
- Track sounds (where is that sound going?)

#### **Fluency through Smell and Taste Activities**

There is relatively less material available to use in exploring the sense of smell and taste. Children can be asked questions like 'what their tongue like best?' They may be encouraged to talk or write about their most delicious foods. Children may be asked their favourite foods of autumn, spring and summer. Similar questions about the sense of smell can be asked. Do not insist on a particular mode of impressions. Just encourage them to express their ideas and try to make an appeal to the senses.

#### **Promoting Critical and Creative Thinking through Story Telling**

As mentioned earlier, knowledge is acquired not only through observation but also communicated through language. Blindness does not seriously interfere with language activities. Story telling methods are very effective in developing creative thinking among the blind children. The basic line in the approach is a story, poem or song, as one might guess from its name. The starting point is often a question to test the previous knowledge of the pupils. The starting point may also be the teachers reading the story. When the students are introduced to the content questions to make them using their fantasy and knowledge are raised to anticipate what happens next, or a question to make them imagine some aspects of the story that are not explicitly formulated. There can be

some questions about what things look like or what people might think or say. A story may follow the following steps

- Listening to story (teacher, radio, television)
- Singing (poem/song) with child
- Questions about the content just heard (recall of important points of the theme)
- Identification of teachers or classmates by sound or the way they talk, their foot-steps and so on
- Telling the child to identify animals and birds by the sound and song they make
- Play games with a ball having sound source inside.

Finally, greater focus should be laid on the following aspects in Story Line Approach:

- Children should be given opportunities when hearing stories to share their laughter, smile and sometimes sigh
- Unexpected outcomes
- Improbable situations
- Funny names, words, titles etc
- Silly characters
- The opposite of what is expected

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# Towards a Taxonomy of Expected Functional Abilities of a Postgraduate Teacher in Physics

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## Abstract

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*In this article the need and justification for professional teacher training programmes, specifically for postgraduate teachers, are reviewed. New emerging dimensions of a training programme for science teachers, in general, are discussed. Functional abilities in four specific dimensions for a postgraduate teacher in physics are identified. The implications of this for preparing postgraduate teachers in physics are discussed.*

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**T**EACHING-learning, in general, and teaching-learning of science (physics), in particular, is a complex activity in a four dimensional mental space (Mohapatra, 1989) resulting in a real, measurable parameter, called the degree of meaningful learning by the learner. The four dimensions are, the Pupil, his/her Alternative conceptions, the Curriculum to be transacted and the Teacher (PACT). Tuxworth (1982) opines that the teacher is the significant agent in causing learning and intellectual development of the learner. In the same spirit Okey and Capie (1980) write that what the teacher does in his/her transactions with the learner makes a difference to the rate and quality of the desired learning. Putting faith in such findings, Competence-Based-Teacher-Education (CBTE) (Marrow, (1975) became a way of life for many involved in teacher preparation in the United States of America. Apart from studies (Rosenshine, 1977; Okey and Capie, 1980) showing a positive correlation between pupils' achievement and teachers' competency, literature does propose (Mohapatra, 1987) a functional dependence of pupils' achievement on teachers' competency. Even in a constructivist approach (Glaserfeld, 1993; Ernest, 1993; Driver, 1995) the form, focus and role of the teacher in the teaching-learning process have become more demanding than ever before.

The importance of functional teaching inside the classroom on consequent learning

by the learner is evident in the reviews of Scheerens (1992), Mortimore (1993) and Creemers (1994). Darling-Hammond (1995) states that knowledgeable teachers and their students in a supportive, caring environment are hallmarks of improving learners' achievement. However, on the basis of a broad-based study, Evans (1996) has concluded that teachers are untrained and ill-prepared to meet their responsibilities. Guskey (1996) re-emphasizes that educators have a professional obligation to keep abreast of the knowledge base in order to be optimally effective.

### **Preparedness of Postgraduate Teachers**

In the backdrop of the above canvas, emphasizing the importance of a competent teacher if one analyzes the scenario of postgraduate teachers (PGTs) in India, the picture that emerges is very bleak. As a case in point, in Madhya Pradesh alone more than 18,000 PGTs have not gone through any professional training course. In Orissa, most of the so-called teachers teaching +2 are untrained, because under the State Council of Higher Secondary Education, +2 classes are attached to colleges and for college teachers (who teach in these classes) going through a professional training programme is not an eligibility condition. The scenario in other states could not be much different.

From the educational planners' and administrators' perspective, it is worthwhile to note that the B.Ed programme (as is in

operation now and the course structure of which is designed to prepare teachers only for the secondary level) has been, so far, used as an umbrella course so that a trainee on passing B.Ed is regarded as having professional abilities to become an effective teacher either at the secondary or at the senior secondary stage. Focussing specifically on science, it is pertinent to note that the science syllabus at the secondary level has an integrated approach, keeping in view the fact that secondary education happens to be the terminal stage for more than 50 per cent of the student population (*Sixth All India Educational Survey, 1995*) and hence should contain just that quantum of knowledge which is necessary to make them scientifically literate citizens. As contrasted with this, the science syllabus at the senior secondary stage has a subject specific differentiated course structure, because it is regarded as the precursor for tertiary courses. Hence at the senior secondary stage

- the expected interaction by the pupils will be more logically consistent as they will be at a cognitively advanced developmental level;
- the problem-solving ability with an eye on divergent thinking has to be promoted;
- active participation by the pupils will be further encouraged in the teaching-learning process;
- the projects to be designed can be geared

to introduce the pupils to some of the research methodologies;

- the demonstrations will have more emphasis on exploration and conjecturing;
- the use of the computer and information technology can be suitably fused to the teaching strategies;
- the evaluation techniques will be different, geared to assess independent thinking ability; and
- self-esteem and ego-involvement of the learner have to be taken into account. This raises two very important questions.
  - Are our PGTs prepared to take up this challenge?
  - Do we have any professional degree/diploma programme to help the PGTs attain the necessary abilities?

Pathetically the answer is 'No' to both questions.

### A Way Out

For a solution to this problem, obviously we have to look for research-based indicators and not perception-based ideas. The National Council of Teacher Education (NCTE), on the basis of field interaction and grass-root survey, has come out with a document, 'Curriculum Framework for Quality Teacher Education', 1998, wherein the necessity for a separate teacher-training programme for PGTs has

been emphasized for the first time and the curriculum framework has been outlined. Even recently, in a UNESCO meeting held on 2 December 1998 at the Indira Gandhi National Open University (IGNOU) the importance and necessity of a teacher training programme for +2 teachers was emphasized. Keeping the above perspectives in view if one analyzes the literature, the dimensions for such a professional curriculum appear. Radford (1998) suggests that instituting reform in science education requires teachers who are knowledgeable in science content, process and inquiring pedagogy. This he called reform-based pedagogical approach (American Association for Advancement of Science, 1990). The project 'Life' of the Louisiana University, U.S.A., provides greater details in this context. Lederman and Gess-Newsome (1992) go a step further in details and advocate that subject matter, knowledge, pedagogical knowledge and pedagogical content knowledge (PCK) are the essential abilities a science teacher must possess. In the framework of PCK, Staver (1998), while discussing constructivism as a sound theory for science teaching, advocates that the teacher know, appreciate and implement the conceptual change approach (Posner et al., 1982) for effective science teaching. Marks (1990) proposes to include under PCK, the knowledge of media for instruction, i.e. role, function, use and effects of verbal, non-verbal, audio tape, video tape, computer-based, etc. media of instruction. Advocating

the role of PCK for improving teaching efficiency, Doyle (1990) and Van Driel et al. (1998) have argued that the focus in process-product research on indicators of effectiveness has led to a fragmented and mechanistic view of teaching in which the complexity of the teaching enterprise is not acknowledged. Van Driel et al. (1998) state that PCK refers to teachers' interpretations and transformations of subject-matter knowledge in the context of facilitating students' efforts to construct knowledge in a way the teachers expect them to construct.

One more dimension that is being particularly emphasized in recent times (Kyle et al., 1991) and which has specific significance for the PGTs is that "the process of recognizing the role of teachers-as-researchers should permeate every teacher education course". Pekarek et al. (1996) recommended that "the notion of teachers as researchers ought to be incorporated in science teacher preparation and professional development programmes". Even recently, Van Zee (1998) has delineated ways to educate prospective teachers as researchers.

The above discussion clearly shows the need for a professional course for PGTs as well as certain specific domains in which science teachers, in general, and a PGT, in particular, should have functional competency. However, to transport these ideas into the curriculum of any professional course (like perhaps B.Ed., Sr.



Secondary, or P.G. diploma for PGTs) one needs to have these domains subsumed under demonstrable abilities. Keeping in view that PGTs are discipline specific, it is clear that the abilities have to partly depend on the discipline also.

### Abilities of PGTs in Physics

While defining abilities in the above framework one should not lose sight of the fact that a PGT in physics is first a teacher and then a teacher of physics. Recently, Cheng and Tusi (1996, 1999) while discussing the total effectiveness of teachers, in general, have proposed a seven dimensional model. The dimensions are

- *goal and task*: emphasizes teacher's personal achievement goals and tasks and school goals;
- *resource utilization*: requires teacher's effective use and procurement of school resources to achieve goals;
- *process*: stresses teacher's contribution to effective teaching and school process;
- *school constituencies' satisfaction*: expects teachers to meet the needs of their students, parents, school, and community;
- *accountability*: focuses on teachers' accountability and professional reputation;
- *absence of problems*: requires teachers to identify and avoid potential problems, weaknesses, dysfunctions, and crises; and
- *continuous learning*: emphasizes teacher's awareness of environmental changes and

continuous improvement and development

However, such a model, because of its effort for comprehensiveness tries to incorporate the teacher's effectiveness in the context of

- in-school and out-of-school,
- academic and non-academic,
- professional and personal, and
- administrative and non-administrative domains.

This holistic perception reduces its degree of implementation

On the other hand, we propose to spell out the teacher's (PGT in physics) classroom effectiveness in terms of focused abilities so that

- the potential PGTs know what they should imbibe;
- the teacher educators comprehend the achievable goals;
- the curriculum framers have a defined framework; and
- the authors realize their domain of drafting the textbooks.

Further, the use of the term 'abilities' instead of 'skill' is recommended, because as per the Oxford Dictionary, 'ability' means 'competence, talent' whereas 'skill' means 'practical ability, dexterity'. Thus, 'skill' is a subset of 'ability'. We propose to classify the abilities into four categories: Anchoring abilities, Abilities in the affective domain, Abilities to teach physics (theory), and Abilities to perform practicals.

### *Anchoring Abilities*

These are the minimum basic abilities as a teacher (although we shall be using the term 'physics', it can equally well be replaced by any other term, like, 'chemistry') and work as supporting undergirders for anchoring of the other abilities. The anchoring abilities are the following.

- Realization that physics is an evolving system having utility and significance in the society-technology context.
- Awareness of the structure and objectives of the physics course at senior secondary for self-assessment.
- Ability to inspire students to study physics.
- Conviction that comprehension of physics concepts are attainable to the extent expected at senior secondary level.
- Appropriate communication skill, both verbal and non-verbal, so that the gap between what the students learn and what the teacher expects them to learn is minimal.
- Organizing ability of an executive.
- Ability to implement democratic atmosphere within the philosophy of 'All for One and One for All'.
- Be a role model to the students.

### *Abilities in the Affective Domain*

Education, essentially, is a process of the development of an individual in all dimensions—cognitive, affective, and psychomotor. The teacher, in general, and the PGT in physics, in particular, as such is

expected to function not only as a purveyor of knowledge but also as a moulder of the student's total personality. Due to a variety of socio-cultural demands, the functions of the teacher having to do with affective domains of education—values, attitudes, interests, appreciation, etc.—have come to be sidelined in recent times and the Affective domain has gradually made its exit from the educational objectives. Education itself has come to mean acquisition of information in the conventional cognitive areas.

However, importance of the school for providing a platform for affective domain oriented education has been stressed in various research studies and articles (Richard, 1968; Lewy, 1968; Milne, 1969; Huges, 1969; Hartshorne and May, 1970; Goodenough, 1972; Brett, 1973; Connelly, 1973; Feather, 1973; Schaffer, 1974; Snider, 1975; Mc Murray, 1977; Fraenkel, 1980; Mohan, 1989). In fact Johnson (1973) observes

When the beauty and the importance as well as the substance of a subject are taught, when pupils appreciate the importance and usefulness of what they are learning, education is an exciting, growth producing experience. Affective reactions to school curriculum may, thus, be in the long run far more important than the mastery of content.

The strength of affective instruction lies in the fact that it takes into account constructs, factors and processes which are conducive to a better teaching-learning

climate in the classroom. It should take into account the ingrained relationship between cognitive and affective, dimensions, between thought, feelings and action. In other words, it should emphasize the psychodynamics of human learning. Keeping this in view a short list of key abilities in the affective domain to be inculcated by PGTs in physics is presented below.

- Self-identification both as a physicist and a teacher.
- Development of self-confidence and the ability to transmit the same to students.
- Sensitivity to the needs of the students and flexibility to provide acceptable modifications.
- Development of the quality of positive discrimination. This is essential because at the initial stage students do not fare well in physics.
- Positive approach to unexpected, sometimes even error-ridden, responses by the students, to questions in physics, which they are expected to answer correctly.
- Ability to inculcate in the students self-dependence in solving problems in physics by abandoning any induced fear psychosis.
- Willingness to update his/her knowledge and learn more about the latest developments in physics.

#### *Abilities to Teach Physics (Theory)*

When one analyzes the classroom strategies

to teach physics (theory) many a time one observes that the abilities demanded of the teacher could be concept specific. For example, the ability to teach equations of motion using graphs is different from the ability needed to teach the intricacies of d.c. electrical circuits or Gauss Theorem. Similarly, the ability to solve problems of, say, optics is different from that needed to solve problems involving Maxwell's equations. A list of such concept and context specific abilities would be too lengthy to peruse, comprehend and then design strategies to develop them in prospective PGTs when they go through a professional training programme. So we decided to stay clear of such a list and catalogue below a set of abilities which are pragmatic, implementable and sustainable.

- Recognize and comprehend the entire physics curriculum as a composite unit consisting of hierarchies.
- Comprehend physical phenomena by using the technique of progressive differentiation
- Understand and correlate events/ instances/attributes/concepts, both basic and derived, leading to laws and principles, like, 'magnetism', 'current through a conductor', 'angular velocity' 'flux', resulting in Faraday's law of electromagnetic induction.
- Appreciate the importance of measurement in physics and transform the data to ideas and concepts, as for example, data on conductors, insulators

and semi-conductors leading to energy-band theory or Millikan's oil drop experiment resulting in the concept of quantization of charge.

- Construct and interpret mathematical equations describing physical situations, like Gauss Theorem in electrostatics, or Stoke's Equation in free fall of a metallic shot through a viscous fluid.
- Diagnose students' alternative concepts and suitably modify them for profitable use, for example students' alternative conceptions about force, current, heat, temperature, laws of reflection, etc.
- Relate physics to life, like, total internal reflection causes a diamond to dazzle.
- Develop ability for questioning as well as for helping students to ask questions, which are likely to promote divergent thinking, clarify concepts, help in analysis, promote the ability to draw inferences.
- Develop in students the ability to construct problems, both numerical as well as conceptual, like, how will a person stranded in an ice pond (frictionless) come to the shore?
- Ability to solve problems (conceptual, numerical and diagramatic).
- Design new problems, in particular multiple-answer-type objective questions, open-ended ones, questions to create cognitive conflict, data sufficiency questions and challenging ones.
- Make an item analysis of question paper in terms of difficulty level, discriminating

ability, reliability and validity.

- Draw and interpret diagrams.
- Draw and interpret graphs.
- Write a scientific report.
- Read and understand a scientific document, which is an essential ability for putting research methodology to practice.
- Appreciate approximations and their limitations, both at theoretical and experimental levels, like, what will be the percentage of error committed in the measurement of torsional rigidity if one commits five per cent error in the measurement of the radius of the experimental wire being twisted.
- Appreciate values like, courage to speak, courage to experiment, unbiasedness, receptive to ideas etc. inherent in physics teaching-learning and help the child to inculcate them.
- Design situations to develop in the students the ability to analyze and draw inferences.
- Skill in evaluation of students' achievement, projects, curriculum and even teaching strategies of ones' own self.
- Use computer in teaching-learning situations.
- Design innovative, simple but exciting experiments to not only teach concepts but also to expose students to processes of physics, in particular, and science, in general.

### *Ability to Perform Practicals*

With the transference of the senior

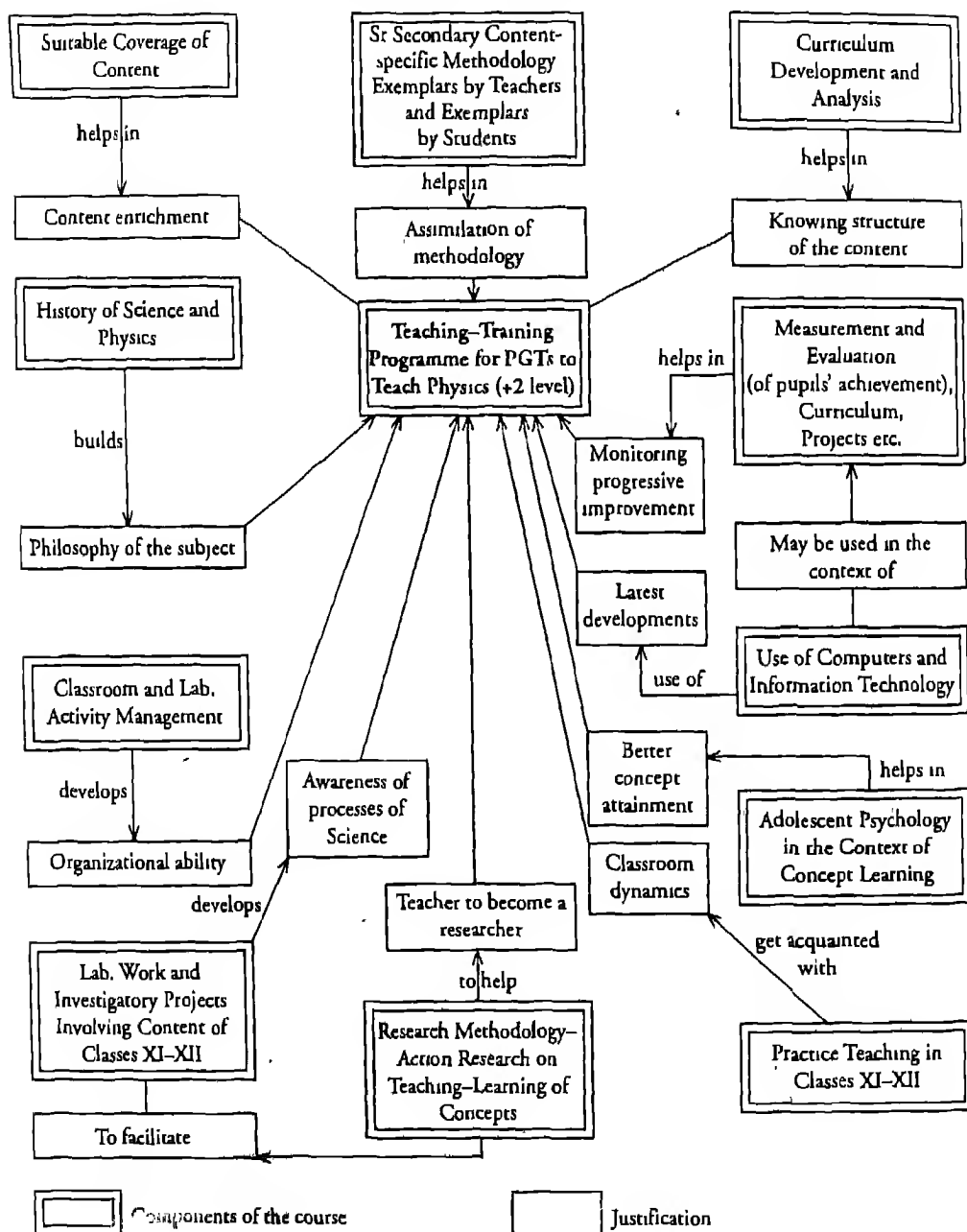
secondary stage to the school system performing practicals has become more of a marginalized, truncated activity to meet the demands of the curriculum than a key component of the teaching-learning process. That practicals are important not only to learn certain skills but also to improve comprehension of concepts, promote divergent thinking, generate curiosity, realize the interplay between experiments and theory for the growth of physics etc. has long been forgotten. In this framework the abilities suggested below are expected to tailor the PGTs to use practicals in a more functional way.

- Well versed in the principles and techniques of measurement. Knowledge of Least Count and range of the instruments essential, in particular, instruments with linear scales, circular scales and scales on an arc.
- Knowledge and expertise of basic laboratory skills such as handling instruments, coordination, setting up experiments involving light and electricity, etc.
- Skill for estimation of errors, using the concept of significant figures.
- Appreciation of limitations of instruments and associated errors.
- Skill of drawing graphs, drawing inferences, interpolation and extrapolation.
- Skill to draw the most appropriate graph for a given data.
- Skill to interpret graphs, sometimes leading to physical laws.

- Ability to identify the variables, dependent and independent, in an experiment.
- Skill to formulate hypothesis and test the same
- Ability to control variables and design an experiment.
- Skill to modify experiment, if need arises.
- Ability to make precise observations.
- Ability to identify and classify the criterion used in classification.
- Design low-cost teaching aids.
- Collect/devise ideas for projects, weigh them and get them done
- Report-writing skill.
- Skill of laboratory management, lab-safety and sense of self-sufficiency.
- Ability to predict the results/incidents on the basis of available data.
- Ability to correlate experiment to theory.

Keeping in view the recent emphasis on developing a professional course for PGTs, in general, and PGTs in physics, in particular, the abilities that a PGT in physics should have, have been identified, classified and presented. Care has been taken to see that the list of abilities is not too detailed and long so that it loses its clarity. The list is also not too short so that it loses its functionality in the framework of improving the quality of classroom dynamics and students' meaningful learning. The list is based on the outcomes of many fruitful discussions with several educationists, educational administrators

## Schematic Representation of the Components of a Professional Training Programme for PGTs in Physics



and planners, and the science education group at the institute regarding what should be the components of a professional training programme for PGTs in physics. These components along with their justifications have been shown schematically in the flow chart on page 12. It is hoped that the taxonomy of list of abilities coupled with the comprehensive

diagrammatic representation of the components will be useful in

- crystallizing the ideas of educational planners;
- focusing the needs felt by educational administrators; and
- providing reference bench-marks for curriculum framers for designing a professional course for PGTs in physics.

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# Alternative Paradigm towards Quality Teacher Education

## Need for Collaborative Change

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### Abstract

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*The present article seeks to build a case for alternative paradigm shift for quality teacher education in accordance with the demands of school education. The alternative paradigm of teacher education must consider structural changes in the system of teacher education, while redefining the teacher's roles within the framework of the school system and education, renewing the teacher education curriculum, building a teacher education system that views preservice and inservice learning as a continuum, and strategically shifting institutional arrangement by bringing the entire teacher education to university level. The need for collaborative change has been suggested to bring about a paradigm shift in teacher education. Therefore, for quality improvement in teacher education, it is imperative that teacher education act in partnership with the school system at one end of the spectrum and the university at the other. The school, the community and teacher training institutions have to move towards building a shared commitment for a paradigm shift in teacher education.*

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## Context

**T**HE global crusade to universalize basic education and improve its quality is now very much on the world agenda especially in the developing countries. Globally, there is overwhelming concern regarding the quality and relevance of education. Undoubtedly, the quality of school education is the direct consequence and outcome of the quality of teachers and the teacher education system. In this context, the importance of the quality of teachers in improving the quality of education is far beyond question. Therefore, quality improvement of our teacher education programme is one of the indispensable needs.

The Education Commission (1964-66) emphatically held "the quality, competence and character of teachers to be the most significant factor influencing the quality of education and its contribution to national development". After more than three decades has not that statement remained a statement with no well-planned initiatives to develop a system of teacher preparation with quality, competence and character? Reforms suggested by various commissions, committees, researchers and educationists are on one end of the spectrum and the *reality of teacher education* on the other.

In recent years, the whole edifice of quality school education has crumbled with the global deterioration of Teaching, Teachers

and Teacher Education. The contemporary model of teacher education though has grown manifold over the decades but is overshadowed by severe criticism for being static and unresponsive to the emerging challenges of the present time. There is a growing feeling that teacher education is not effective in turning out efficient teachers and this concern is adequately reflected in the National Policy of Education (1986) and the Programme of Action (1992). The knowledge, skills and methodologies propagated by the system remain alien and never get assimilated in the school system. Teacher education continues to be viewed in isolation, disconnected from other factors that shape the role and performance of a teacher — recruitment, salary, working conditions and overall professional development. At this juncture, could we really afford to tolerate the slow change/resistance towards change in the system of teacher education and quality, which have so major an impact on the total quality of the educational endeavour? Over the years, few initiatives have been taken in the area of teacher education to translate policy to practice.

### Initiatives towards Quality Teacher Education

Over the years, various steps have been taken to improve the quality of teacher education. As a sequel to the National Policy on Education and the Programme of Action a number of planned initiatives

have been launched by the establishment of District Institutes of Education and Training (DIETs) and strengthening of teacher training institutions to Institutes of Advanced Studies in Education (IASE) and Colleges of Teacher Education (CTE) to provide quality preservice and inservice education to teachers.

The establishment of the National Council of Teacher Education (NCTE) and its curriculum framework have been welcomed as a dynamic step in moving towards quality teacher education. As a major initiative, a competency-based and commitment-oriented curriculum for quality teacher education has been developed. Evidently, the scope of the suggestive curriculum framework (1998) of teacher education has been developed keeping in view the country's need for different kinds of teachers to manage its educational system with efficiency and professionalism. A broad curriculum framework has been spelt out for different stages of school education. The framework has also suggested increase in the duration of the B.Ed. programme to ensure professionalism in teacher education and to provide a strong base for pursuing M.Ed. programmes. It further presupposes that the duration will suitably be adjusted with the entry qualifications to bridge the mismatch between the needs of teacher education institutions and professional preparation of teacher educators working in such institutions

Besides this, some of the innovations in teacher education have been carried out by introducing a four-year integrated teacher education programme (B.A., B.Ed./B.Sc., B.Ed.) and M.Sc. Ed. programme (for the teachers of the +2 stage). The programme has been developed on the premise that pedagogy for a subject should form an integral part of its content. Apart from this, some universities have attempted to introduce degree courses leading to primary teacher training. Introduction of B.El. Ed. in the Delhi University is a pointer in this regard.

Diversity in the teacher education programme is also emerging. Teachers for special education, for work education, higher education, non-formal and adult education and teachers working in the other professional sectors of education have been occupying their due places in the broad domain of teacher education.

All these efforts are aimed at translating the policy into effective practice for qualitative improvement in the teacher education system. It is clear that mere curriculum revision by NCTE will not suffice to improve the quality of training in the country. Nor will the establishment of institutional facilities such as DIETs, Block Resource Centres (BRC) and Cluster Resource Centres (CRC) be able to address the problems of teacher training — both preservice and inservice. However, the reforms attempted over the last few years have aimed at introducing improvement

rather than restructuring the overall teacher education model. But the system is afflicted with such a deep-rooted malaise that it requires an overall paradigm shift.

### **Alternative Paradigm**

Teacher education needs to remain effective and functional to cope with changes occurring in quick succession in school and society and challenges to be faced in the new millennium. The building of 'new education' and 'the new teacher role' call for integral and urgent measures directed towards expansion in the role of teachers necessitating change in the teacher education structure, design and curriculum. The International Commission on Education (1996) stressed the need for

- attracting to the teaching profession more talented and academically prepared persons;
- motivation and awareness for continuous upgradation of one's academic and professional competencies.

The concept of alternative paradigm in teacher education can be thought of as a matrix of beliefs and assumptions about the nature of schooling, teaching, teachers and their education that would provide a form of practice in teacher education. This alternative paradigm seeks to build a case and could legitimately argue for a shift towards quality teacher education in accordance with the demands of school education and society. The suggestive paradigm is based on argument and assump-

tion, analyzing the extensively existing structure, policy, actions and meagre research support. Further, the paper seeks to direct the attention of planners and teacher educators to a fundamental question related to the purpose and goal of teacher education. The suggested alternative paradigm in teacher education would take into account structural change in the system of teacher education, defining the teacher's role within the framework of the necessary redefinition of the role of the school system and education, enhancing entry qualifications, expanding duration, modifying curriculum and practice teaching, and changing institutional arrangement.

#### *1. Stage-specific Structural Change*

The structure of school education in our country comprises four levels i.e., pre-primary, elementary (I-VIII), secondary (IX-X), senior secondary (XI-XII). The existing system of teacher education has no synchronization with the sub-stages of school education. It has been observed that teachers possessing qualifications like BTC/JBT/CT/DEd. are eligible for teaching Classes I-V and, in some cases, for teaching the upper primary classes (VI-VII). On the other hand, B.Ed. degree holders are also eligible for teaching Classes VI-XII i.e. upper primary level to the senior secondary stage. Hence, to teach at the upper primary level, both elementary and secondary teachers are eligible causing much anomalies and

raising questions of teachers' ability to negotiate curriculum in relation to their differential qualification and training inputs. The recent development in school curriculum has made it difficult for teachers with senior secondary qualification to teach subjects like maths and science in Classes VI-VII. Even at the secondary stage, graduates find it difficult to teach Classes IX and X which demand subject-specific teaching. Hence, a structural change is required in the contemporary model of teacher education so that it synchronizes with the sub-stages of school education.

With the transformation of the Elementary Teacher Training Institutions (ETTI) to DIETs, it would be in the fitness of things to develop one programme for the elementary stage (Class I-VIII). The secondary teacher education should also have one programme (Classes IX-XII) wherein the senior secondary teacher preparation programme can be subsumed. Hence, the structural change in teacher education requires only two programmes, i.e., elementary (I-VIII), and secondary (IX-XII) with improved academic qualifications.

## *2. Enhancing Entry Qualifications*

The present system of teacher education is based on the assumption that a lower academic qualification is required to teach at the lower level of education, i.e. the elementary level. Hence, varying levels of

entry qualifications are prescribed for the teacher education programme for different stages of school education. The elementary teacher education programmes in different states require matriculation or higher secondary (+2) pass as the entry qualification. DIETs have prescribed senior secondary (Arts, Science or Commerce) as the desired qualification for admission to the preservice teacher education course offered by them.

In case of secondary teacher education, the admission requirement is uniformly a Bachelor's degree in Arts, Science or Commerce. An integrated course of four years' duration for preparing secondary teachers is also in existence in the Regional Institutes of Education, NCERT. The teachers with postgraduate qualifications along with B.Ed. are eligible to teach at the +2 stage which has been integrated with the existing school system after the implementation of the 10+2+3 pattern of education.

However, with the ever increasing amount of knowledge and information on the one hand and the changing school curriculum on the other, teachers with a higher level of competencies will be required. The present trend envisages a positive direction as most of the entrants for elementary and secondary teacher education programmes are graduates and postgraduates respectively. The assumption regarding lower qualification at the lower level was the guiding principle a

decade back, keeping in view the then prevalent low enrolment and shortage of teachers and their inadequate work load. However, this assumption no longer holds true in the present time. A number of studies on need assessment have shown the content knowledge deficiencies of teachers teaching at the primary stage (Bashir, 1994; Gupta, 1996; Arora et al., 1997). This implies that the basic qualification of elementary school teachers would have to be raised to graduation level to teach Classes I-VIII. Likewise the basic qualification for secondary school teachers would have to be raised from the present graduation level to postgraduation level corresponding to the suggested structural change in the teacher education programme.

### 3. Strategic Shift from Class Teacher/Multiple Subjects Teacher to Subject Teacher

The structural change and enhanced entry qualifications discussed above also demand a strategic shift from class teacher system to subject teacher system at the elementary level. Hence, the conceptual clarity regarding the desirability of class teaching vs. subject teaching shall certainly help to strengthen the teacher education system. Class teaching at the primary stage does not make primary teachers of varied backgrounds sufficiently confident to transact different subjects with the same level of confidence. The teacher may face problems depending on his/her academic

background of science or humanities. Accordingly, the system of class teaching in primary schools expects a teacher trainee to undergo training in all curricular areas. However, it may be difficult for a teacher of arts background to teach subjects like science and maths at Classes VI-VIII level and non-scholastic areas like art, music and dance which under the present circumstances require professional training. At the secondary stage, a teacher is called upon to teach two subjects depending on his/her background. But the present school curriculum requires subject specialization like physics, chemistry, mathematics, language, geography, history, economics and a postgraduation qualification in the concerned subject appears to be essential keeping in view the present day realities in school education. Hence the *class teacher system/multiple subject teaching* may be replaced by the *subject teacher system* wherein the teacher has mastery over the content areas.

### 4. Shift in Practice Teaching

The teacher education curriculum at the primary and secondary stages is generally based upon the teacher education curriculum framework brought out by NCTE (1978 and 1988). The organization of curricula for both elementary and secondary teacher education is very similar in its theoretical perspectives. However, the content of various courses at the

secondary stage is of a slightly higher level in terms of number of syllabus components on the one hand and comprehensiveness on the other. A very conspicuous difference is in the number of teaching subjects a trainee has to offer.

An elementary teacher trainee under practice teaching teaches all the subjects at the primary stage (Classes I-V) and one or two subjects at the upper primary stage (Classes VI-VIII). A secondary teacher trainee teaches two subjects of his/her specialization from Class VI to Class X but he/she might not have studied the subject at the graduation level. Thus, two points can be noted for suggesting an alternative paradigm, i.e., overlapping of practice teaching at the upper primary level (Classes VI-VIII) and efficiency to negotiate a subject not studied at the graduation level. Hence, supporting the argument of structural change, enhanced entry qualifications and subject teaching, the practice teaching should be confined to two subjects at the elementary teacher education programme and one subject at the secondary teacher training level.

### 5. *Shift in Programme Duration*

A profession generally requires a prolonged period of preparation along with a sizable body of specialized knowledge and observance of professional ethics by its members. Though establishment of DIETs has brought about uniformity in the duration (two years) of the elementary teacher edu-

cation programme, some states follow elementary teacher training of different durations resulting in a lot of *ad-hocism*.

The duration of the present teacher preparation programme for the secondary stage is of one year. The secondary teacher education programme, leading to the B.Ed. degree, has multiple scope in our country as it entails a person to teach at the elementary, secondary and senior secondary levels. Integrated courses of longer duration have been planned and offered in some universities. The four-year integrated teacher education programme leading to a combined degree of B.Sc., B.Ed. has been going on successfully in the four Regional Institutes of Education. In the recent past, a few more institutions have started integrated programmes. There are studies to indicate that the product of these integrated programmes are superior to the product of the one-year teacher education programme. The difference in effectiveness is attributed to several factors which include selection of meritorious students, programmed duration, integrated curriculum allowing simultaneous teaching of content and methods of teaching. Unfortunately, the experiment having the potential of professionalizing the teaching profession has not been extensively implemented in spite of unambiguous support from several commissions and committees. The Chattopadhyaya Commission (1985) supporting the integrated programme of teacher education



recommended establishment of one four-year integrated College of Education in each state.

The recent initiative of NCTE in extending the duration of B.Ed. from one year to two years in selected institutions has translated a long felt need and demand of teacher educators, educationists and recommendations of commissions and committees to inculcate professionalism in the teacher education programme.

In the years to come, the credibility of teacher education institutions will depend upon the rigour and richness of the programme they conduct and the research base on which these programmes are planned, developed and implemented. Institutions of teacher preparation will have to become comprehensive, characterized by sound approach, extensive rigour and sufficient preparation.

The above argument thus necessitates two programmes of teacher preparation, one at the elementary (I-VIII) and the other at the secondary (IX-XII) level.

The present elementary teacher education programmes of ETTIs, Junior Basic Training (JBT) and Certificate of Teaching (CT) may be substituted with one terminology i.e. B.Ed. (Elementary) of two years' duration by raising entry qualification from +2 to graduation, and an alternative integrated programme of teacher preparation (B.A./B.Sc./B.Com., B.Ed.) may also be reintroduced in each and every university. The product of this

programme may be eligible to teach Classes I to VIII as Elementary School Teacher (EST). Similarly, at the B.Ed secondary level, entry qualification may be raised from graduation to postgraduation degree with one year teacher preparation and having knowledge of pedagogy in one subject. These teachers would be eligible to teach Classes IX-XII as Subject Specialized Teachers (SST).

#### *6. Shift in Mode of Teacher Preparation*

The organization of teacher education programme has been institution based but during the past few decades, distance mode has taken a prominent place. It has its genesis in the summer course leading to B.Ed. degree offered in the RIEs of NCERT. Gradual commercialization and introduction of correspondence courses have raised a question with regard to the validity of distance mode as a strategy of professional preparation. On the other hand distance education is acknowledged worldwide as a valid strategy for professional education. It is often stated that open learning and distance education are likely to prove as effective as institution-based training provided the programme is conducted with due rigour using multi-mode approach. The provision of self learning, followed by frequent contact programmes at the accredited institutions and periodic teleconferencing shall go a long way in enhancing the quality of any professional preparation programme.

In a broader perspective, the component of distance education in the recent decade must find place in the traditional face-to-face mode in the form of multi-channel mode, self learning materials, teleconferencing to bring rigour and professionalism in teacher preparation. Hence, distance mode may be viewed in a wider perspective and included both in preservice and inservice teacher preparation which can widen the horizon of teacher preparation to cope with the demand of self-learning and lifelong education. The distance mode can very well be integrated to the traditional face-to-face mode of teacher preparation with constructive efforts and meticulous planning.

### *7. Strategic Shift in Institutional Arrangements*

Secondary teacher education in the existing structure is part of the higher education system and is organized either in a department of a university or in a separate B.Ed. college. Universities grant affiliation to colleges of secondary teacher education under their jurisdiction provided they fulfill the prescribed conditions. On the other hand, the Department of Education of the state government controls elementary teacher education institutions directly or through the SCERTs. The Education Commission (1966) has envisaged that, "all teacher training programmes irrespective of the states concerned should be at the collegiate level". In fact, India is one of

the very few countries where primary teacher training is not at the university level which has indirectly an adverse effect on the economic and social status of the teacher. This, in turn, affects the teacher's pride in the profession and, consequently, performance. In educationally advanced countries, the entire teacher education system is a part of the university system and is characterized by equal rigour and prestige like other disciplines. As the university degree has much respectability and status in our society, teacher education of all levels may form part of the university system to enhance the status of the teaching profession and to improve the quality of teacher education. The genesis of teacher education is multi-disciplinary which, as part of the higher education system, may find its rightful place by embracing inputs from all disciplines. Inclusion of all institutions of teacher preparation as part of the university system can bring rigour, quality, qualified entrants, qualified teacher educators to enhance the status of the teaching force of our country.

### *Alternative Paradigm Matrix towards Quality Teacher Education*

- Structural change
- Enhancing entry qualifications
- Shift from class teacher to subject teacher
- Shift in curriculum and practice teaching
- Shift in programme duration

- Shift in mode of teacher preparation
- Shift in institutional arrangement.

### **Translating Paradigm into Action**

The above suggestive alternative paradigm for quality teacher education should be translated into action plan. The above discussion suggests two teacher preparations and cadres i.e. B.Ed. (Elementary) and B.Ed. (Secondary) which would correct the existing anomalies. Accordingly, entry qualifications may be enhanced both at elementary and secondary levels to that of graduation and postgraduation respectively. The product of these programmes may be eligible to teach Classes I to VIII as elementary school teachers (EST) and on the other hand, the secondary teachers would be eligible to teach Classes IX to XII as subject specialized teachers. The practice teaching may confine to two subjects at the elementary level and to one subject at the secondary level. Substantiating the above argument, duration may be extended to four years' integrated teacher education programme after +2 and two years after graduation for the elementary teacher training programme. Accordingly, at the secondary level, duration may confine to one year of teacher preparation with postgraduate qualification. Distance education may take due place in the mode of teacher preparation by adapting a multichannel mode. It suggests two cadres of teachers i.e. EST and SST in the school system in place of the existing three

levels i.e. primary teachers (PRT), trained graduate teachers (TGT) and post graduate teachers (PGT). The suggestive paradigm towards quality teacher education has been presented in Table 1.

### **Need for Collaborative Change**

Collaborative change has been suggested to dissolve the existing isolation of teacher education. An alternative paradigm towards quality teacher education cannot be visualized in isolation; it requires mutual and collaborative efforts from schools, peer institutions, universities and the community at large.

It is important to note that 'teacher education cannot transcend teaching practice'. Therefore, for quality improvement in teacher education it is imperative that teacher education act in partnership with families, industry, business, voluntary agencies, people active in cultural life and teacher organizations. Academic and social issues are interrelated and interdependent. In the contemporary context, any change visualized in the sphere of teacher education needs collaborative efforts from all. The school, community, teacher training institutions and the university system have to move collaboratively towards building a shared commitment for a paradigm shift in teacher education. Also, to ensure effective and efficient implementation of the teacher education programme, collaboration and networking are essential. The NPE (1986)

TABLE I  
Alternative Paradigm towards Quality Teacher Education

Stages of School Education	Structural Change	Entry Qualification	Duration	Subject Teaching and Class	Practice Teaching	Mode	Institutional Placement	Status	Scale of Pay
Primary (I-V) Upper Primary (VI-VIII) Elementary (I-VIII)	B.Ed. (Elementary) (I-VIII)	Graduate Sr Secondary	2 years 4 years	Subject Teaching (Classes V-VIII)	Two subjects	Face-to- Face + Distance mode	Part of university system	EST	TGT
Secondary (VI-X) Sr Secondary (IX-XII)	B.Ed. (Secondary) (IX-XII)	Postgraduation	1 Year	Subject Teaching (Classes IX-XII)	One subject	Face-to- Face + Distance mode	Part of university system	SST	PGT

EST – Elementary School Teacher

SST – Subject Specialized Teacher

TGT – Trained Graduate Teacher

PGT – Postgraduate Teacher

also visualizes creation of networking arrangements between institutions of teacher education and university departments of education

It is needless to say that this is mutually beneficial to all stakeholders and the society at large. The organization of teacher education programme has to be such that it builds local level partnership at the institutional level between the teacher training institutions and schools in the neighbourhood. In the present day context, teacher education institutions need to keep in continuous touch with institutions of higher learning and peer institutions for effective transmission of knowledge and upgradation.

Quality teacher education looks for quality performance. It should be recognized that advances in education depend largely on the qualification, ability of the teaching staff in general and on the human, pedagogical and technical qualities of the individual teacher (*Status of Teachers*, ILO, 1966). Collaborative change must bridge the gap between needs for education and status of teachers. It should be recognized that the proper status of teachers and due public regard for the profession can be established by mutual

effort and not in isolation.

Hence, structural change/shift, change in curriculum and practice teaching, enhanced entry qualifications and collaborative efforts from all sectors can rebuild the lost glory of teacher education by giving due recognition to it as a profession.

The preparation and upgradation of human resources in any field require long-term and sustained effort. Hence, a strategic vision towards quality teacher education is essential to transform teacher education as a strategy in itself. Teacher education as a continuous process needs prioritization to implement an alternative paradigm for quality teacher education. The school community and the teacher training institutions have to move towards building a shared commitment for a paradigm shift in teacher education. Hence an alternative paradigm towards quality teacher education does not call for more of the same—more time, more subjects, more courses—but for a transformation based on its utility for the school and the society. In the new millennium, teacher education should be built on the premise: 'teacher education—of the people, by the people and for the people to attain Quality Education for All'.

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# Computer-based Instruction in Developing Reading Skill among Primary Children

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## Abstract

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*Boards of Examiners at various levels lament over the fall of standards of students in language skills. Unless they are proficient in language skills viz. listening, speaking, reading and writing, they cannot express their views effectively. Hence, it is high time that language teachers, particularly at the primary level, made earnest efforts in this direction. The task would become easy, if the teacher adopted a medium in this attempt. The effectiveness of the computer as an aid in teaching has long been established. Let us discuss how it can best be used as an instructional medium in teaching 'reading' to primary school children.*

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**O**NLY a few people had the insight to foresee that computers would be as popular as hand-held calculators. This influx of computers into all sectors of our society has changed the way we live and think. Computer technology inevitably affects our teaching strategies also. However, we have to examine how computers can complement what we know to be effective strategies for teaching reading besides evaluating whether computers and relevant software have made our students better readers.

A review of previous Computer-aided Instruction (CAI) studies reveals a number of facts which include

- CAI is most effective in the areas of science, maths and foreign languages. It is less effective in reading and language arts (Fisher, 1983; Merton, 1983).
- CAI is at least as effective as traditional instruction and may lead to significant improvements in some subject areas (Holmes, 1982).
- Children are highly enthusiastic about working with computers and academic motivation usually improves (Spencer and Baskin, 1983).
- Children learn instructional materials at a faster rate — in some cases up to 40 per cent faster when computers are used (Hofmeister, 1982).
- CAI is most effective when used with low achieving or high achieving groups rather than with entire student populations (Fisher, 1983).

The effectiveness of CAI may lie in the fact that the computer is able to deliver focused instruction at a level of student need. Between 70 to 80 per cent of the instructional time is spent in giving directions and supervising learners as they complete worksheets (Mason, 1982). A small amount of time is actually devoted to teaching-reading comprehension skills (Durkin, 1978). A computer can provide additional drill and practice that cannot be provided by the teacher. It permits the learners to spend more time on instructional tasks (Holmes, 1982).

The potential danger in the use of CAI in the teaching-learning process is the reduction of fruitful communication among students. It could have a deleterious effect on the social environment of the classroom (Deford, 1981; Rubin, 1983). As the learners become more responsible for their learning and as computers play a greater role in instruction, it is pertinent to ascertain whether teachers need to alter their teaching behaviour. It is also equally important to observe that without examining the long-term instructional effects of CAI, we should not heavily invest on computers for instructional purpose.

### **Modes of Computer-based Instruction**

CAI software can be categorized under a variety of modes which include drill and practice, tutorial, games, simulations and teacher utilities.



### *Drill and Practice*

It provides practice on skills previously taught. The program is so designed that the student gets drilled until a skill is not only learnt but is brought to a state where the response becomes automatic (Gagné, 1982). When decoding skills are overlearned until they become automatic, the learner can devote a greater portion of his attention to comprehending the written material (LaBerge and Samuels, 1974). Providing repeated drilling of the same material by the teacher may be uninteresting to both the teacher and the taught. However CAI, in drill practice mode, permits students to work at different levels. The same instructional unit can be presented a number of times occurring in a different order. It also provides opportunities for the students to review skills that may have been missed earlier. The systematic design of the material permits the user to proceed, step by step, through a logical instructional sequence.

### *Tutorial Mode*

Tutorial program is designed to present small increments of information followed by questions assessing the learner's comprehension of the instructional content. It teaches concepts in much the same way a teacher would in a one-on-one situation (Gawronski and West, 1982). Here, the learner interacts with the computer rather than with a text besides proceeding at his own pace. Students who

can grasp the content move ahead while those who feel difficulty are directed to learn other things that reinforce the objectives of the instruction.

Correlation with the existing curriculum materials, moving ahead fast enough so as to maintain students' interest and innumerable branches enabling those who experience difficulty initially to have adequate review lessons would make a tutorial program very effective.

### *Instructional Games*

Instructional games are activities that are played with a prescribed set of rules and usually result in a winner at the completion of the activity. Games make the learners practise physiological, mental and social skills that improve their fitness besides fostering cooperation among them (Goles, 1982). Games should be integrated into the day-to-day curriculum of the school. If they are not tied to curricular goals, they may be played outside the school. Since students love to use their imagination, games can provide an excellent vehicle to impart knowledge in an enjoyable manner.

### *Simulations*

These programs are designed to depict real-world happenings without the danger, expense or time needed to experience the actual event. They provide continuous feedback to the user regarding the status of the event and the options available (Saltinski, 1981). When we consider that

learning to read is a process, it only makes good sense to teach reading in meaningful contexts. Given material written at their instructional level, learners are joyful consumers.

Simulations are highly motivating since there is continual input required of the user. Instantaneous feedback guides students as they proceed through the material permitting them to try different approaches besides discovering those that are successful. Simulations permit learning experiences that are simply beyond the capability of textbooks besides involving the learner in the instructional process and thereby permitting learning to be internalized through continuous practice in life-like situations (Henney and Boysen, 1979).

Much of the on-screen and written documentation is beyond the reading capability of the poor students. Some simulation programs depict events in simplistic and unnatural ways. Unless the simulation represents the real-world event, students may develop inappropriate understanding of the event.

### *Teacher Utility Software*

It refers to programs used to prepare instructional materials or to keep record of learners' progress in the instructional process. It includes a variety of programs such as word processing, data-base management, authoring packages, classroom management system, etc. The

classroom management system helps the teacher monitor the progress of the students as they move through a prescribed curriculum. It permits the teacher to organize, store, evaluate and report information on pupils' achievement.

### *Software for Reading*

Lass (1981) identified a number of characteristics that typify good teachers of reading which include

- Ability to organize and manage instruction
- Ability to attend to individual needs
- Ability to pace instruction correctly
- Skill at maintaining student attention
- Monitoring of student achievement
- Provision of one-to-one instruction when needed, and
- Use of supplementary material.

A quality computer software should complement the teachers of reading in their efforts to attain these goals.

### *Readiness and Reading*

Reading readiness and reading are on a continuum and it is impossible to divide where one ends and the other begins (Durkin, 1978). Hence, it is a challenging experience for a teacher who finds and uses a software to reinforce reading readiness skills. Special consideration must be given to the age and maturity level of the users. So, it is pertinent that the teachers must decide on the operational definition of 'readiness' and then determine whether the

software fits their definition and expectations. Readiness software can be used by the learners without extensive supervision by the teachers for the skills needed by them.

### *Teaching Decoding*

Decoding skills include the skills within the categories viz. sight, vocabulary, phonics and structural analysis.

**Sight Vocabulary :** It implies the instantaneous recognition of printed words. It may also mean words that appear with high frequency in oral language or print. It can also be defined as those words presented in software designed to improve a learner's vocabulary because it serves the purpose of being able to include many vocabulary software packages that might be overlooked if a narrower definition were used.

Some vocabulary software attempt to improve the learners' vocabulary through the matching of target words and definitions. They are provided with immediate visual and aural feedback upon making their selection. At the end of each unit, the computer accounts the student's score. Some programs also provide listing of missed words accompanied by their appropriate definitions.

Some programs aim at improving students' knowledge of prefixes and root words. A short tutorial explains the use of the prefixes and root in the target word.

Some programs use the cassette-control device to permit the cassette recorder to supply the aural stimulus while the printed word appears on the screen. This ensures that the learner hears the correct pronunciation of the target word. Words are retained only if they are learnt in meaningful contextual settings that permit a linking of past experiences with the newly introduced ones. Unless embedded in a context, new vocabularies may be easily forgotten.

**Phonic Skills :** The phonological, semantic and syntactic cueing systems comprise the three processes by which learners unlock unfamiliar words. Phonics has always played an important part in reading instruction. Some programs present exercises that require students to use consonant or vowel substitutions to derive new words. Exercises like the present one fall short of being true decoding exercises. Having a student identify letters that represent other words is not a decoding exercise at all. Rather it is an encoding exercise. Also, the students may be unable to read the words, yet may be able to recognize the letters as a word or may even be lucky and simply guess correctly. Hence, the teachers should be cautious when assigning phonics-related software.

**Structural Analysis Skills:** Contractions, affixes, plurals, synonyms, antonyms and homonyms are typical skills that are

included under this category. Distinguishing homonyms is a skill that appears with recurring frequency in reading software. Some software focus on the teaching of antonyms and synonyms. Contractions software covers the use of n't, 'd and 'll. A screen of the two base words along with the contracted form of the words is used as a tutorial. Once the words are read, the computer requires the student to spell the contraction by commanding. Here, the learners may be given the exercises that require them to identify, in a sentence context, the two words to be contracted.

### **Teacher Utilities Software**

The teacher utilities software includes word processing, electronic dictionaries and electronic thesauruses.

#### *Word Processing*

Word processing has the potential to change the way in which we communicate and learn from one another. Watt and Parham (1983) state "the word processor offers the prospect of substantially narrowing the gap between the immediate but fluid world of speech and the past but fixed world of print". Many children are writers even before they enter school. Preschoolers try to emulate the writing of their elders. Children first encounter print upon entering kindergarten or first grade where the formation of letters, words and syntactic sense are stressed. It is believed

that only through writing does writing improve. However, the problem with writing instruction is that there is no writing.

Once learners demonstrate reasonable command in word processing, they can create their own masterpieces. Student generated newspapers are an excellent example of how word processors can contribute to meaningful communication among learners. Students can elect an editorial board, feature editors and staff editors. All the students can be encouraged to submit articles for inclusion in such a venture. Recipes can be a meaningful way for students to share information as well as to illustrate the importance of following directions. List-making is an interesting activity. It may take a variety of forms. Even reluctant readers can usually find a list that appeals to them. Students can maintain a diary or journal for a period of weeks or months. The ease with which files can be retrieved and edited makes word processing an excellent way to encourage writing. Ease of correction, revision and formatting and quantity and quality of writing make word processing an excellent teacher utility in the classroom for teaching reading and writing.

#### *Electronic Dictionaries*

Electronic dictionaries are programs that permit users to check the spelling of all the words in a document against a dictionary of known words that are stored in the

computer's random access memory. Most electronic dictionaries highlight unrecognized words on the screen and ask the user whether the spelling is correct. The alternative spelling of unrecognized words are also offered. The more the words in the dictionary, the less the interaction needed between the user and the computer. With the help of electronic dictionaries, compositions can be proof-read quickly and accurately besides automatic checking of the documents. They free students to concentrate on the content of a composition rather than worry needlessly about spelling. Content-specific words may be identified as possible misspellings.

### *Electronic Thesauruses*

Electronic thesauruses are more recent developments than spelling checkers to teach synonyms and antonyms. A keyboard command activates the thesaurus. The speed with which synonyms can be found and inserted into text is an obvious advantage of the electronic thesaurus. This does not require a separate book cluttering the writer's work space. The learners can play with the various shades and meanings of words with the help of electronic thesauruses and thus colour their writings to better reflect the intent or mood of a passage.

### **Specialized Classroom Applications**

Readability Analysis Programs, Speed

Reading Programs, Authoring Systems and Administrative Software are some of the specialized classroom applications.

### *Readability Analysis Programs*

Appropriate materials for particular students can be determined by employing a readability formula to compute the reading level. These formulas make the teacher examine such factors as sentence length, number of syllables, or number of frequently used words in a 100 word sample. The formula thus gives a score which represents a grade-level approximation of the material. Readability software greatly eases the chore of determining the reading level of the learning materials. The computer scans the entered data and the computed results appear on the screen in a few seconds.

### *Speed Reading Programs*

By training the eyes to move rapidly across the page, we can improve the learners' reading comprehension with speed. Efficient eye fixations lead to more rapid reading and hence improved comprehension. The speed reading programs allow the learner to adjust the rate at which words appear on the screen. As reading rate and comprehension increase, the learner can continue to increase the speed at which words appear. Speed reading software can be used whenever desired besides being easy to use. They contain stories with widespread appeal for learners of any age.

They also do the job of student record keeping. However, instruments and practices devoted to training eye movements are the dinosaurs of the reading profession (Moore, 1983).

### *Authoring Systems*

These systems can be used by the teachers to design their own instructional materials for the learners. They are the result of a need by individuals to produce instructional material without having to learn the intricacies of learning a complex computer language. These systems permit the teacher to design CAI material with a minimum of training. These programs require the teacher to provide information for text, test questions, anticipated responses, unanticipated responses, feedback responses and hints. They also provide for a number of test formats, record keeping capability and item statistics. Comparatively, authoring packages are less expensive. Teachers are disenchanted with the simple, linear programing paradigm that is used as a template. They do not permit the learners to pursue alternate paths to learn similar information (Robert, 1986).

### *Administrative Software*

Teachers are responsible for maintaining student reading records. This software is based on the principle of data-base management. These programs manipulate data according to user-defined specifications. They permit the teacher to have untold amounts of information at his/her fingertips besides reducing the amount of repetitive paper work. They also allow easy addition and deletion of information without the necessity of retyping entire rosters. Producing an up-to-date report is comparatively easier. But these systems are very costly. Schools being very large, the data to be stored exceeds the memory capabilities of the system.

Overall, CAI can result in a number of positive benefits when used for developing reading skill among children at the primary level. With more and more reading software packages appearing the teacher has to become a critical consumer. Selecting high-quality reading software is a personal matter that varies from teacher to teacher. It is quite obvious that the time has come for teachers to move into the educational computing arena gracefully and with confidence.

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# Entrepreneurship

## A Way to Employment Generation among Tribal and Non-tribal Educated Rural Youth of Southern Rajasthan

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### *Abstract*

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*The youth of India are a vital and vibrant segment of the country. The youth population of the country is expected to increase to 356 million very soon. They are basic investments for the future and will shape the society of India. Unemployment and channelization of youth have become serious concerns of society. It is time that their preferences for vocations took priority. These, in turn, need to be built into the curriculum.*

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**T**HE future of any developing country depends on the lines on which the youth are moulded. The importance of youth in India is self-evident. The Indian youth population is not only large in number but is also vigorous and active, open and responsive to new ideas and changes. About 30 per cent of the population in India is in the age group of 15-35 years. For this reason, the youth in India represent an extraordinarily important group. India is still predominantly agricultural; more than 70 per cent of the youth population in the age group of 15-35 years lives in rural areas and is mostly engaged in agriculture.

The environment in the rural areas is not conducive for its development. The educated rural youth do not have any incentive to stay back in the village and work for its development. Unemployment amongst the educated rural youth has been one of the burning problems faced by the country in recent years. Wastage of manpower causes poverty, backwardness and ultimately results in migration to urban areas.

Today's educated youth is interested in white- and blue-collar jobs after completing or leaving school and college education. The problem of unemployment is omnipresent in India for the youth. This is more serious among rural youth, be they tribal or non-tribal.

The problem of unemployment cannot be resolved unless the educated rural youth

are trained and involved in entrepreneurship-oriented vocations. In this context, the Government of India lays special emphasis on vocational education. Earlier, the previous government wanted at least 10 per cent of higher secondary school students to be enrolled for vocational courses. But even that target has not been achieved.

It is high time we took a look at the preferential choice of educated tribal and non-tribal rural youth regarding entrepreneurship-oriented vocations, so that these could be incorporated in the school curriculum, thereby helping these youth in getting employment opportunities after completing their education. With this view, the present research study entitled, 'Entrepreneurship: a Way to Employment Generation among Tribal and Non-tribal Rural Youth of Southern Rajasthan', was undertaken

### Objective

To study the preferential choice of youth regarding entrepreneurship-oriented vocations to be included in developing employment generating course curriculum.

### Methodology

The present study was conducted in the selected villages of one panchayat samiti each from Districts Udaipur, Chittorgarh, Dungarpur and Banswara of Rajasthan State. The sample size consisted of 175 tribal educated rural youth from Dungarpur and Banswara Districts and 175 non-tribal educated rural youth from

Udaipur and Chittorgarh Districts. The total respondents numbered 350.

According to educational qualification, the youth were classified into three strata. Tribals were designated as 'T' and non-tribals as 'NT'. The three strata of tribals were designated 'T<sub>1</sub>', 'T<sub>2</sub>' and 'T<sub>3</sub>' and the non-tribals, 'NT<sub>1</sub>', 'NT<sub>2</sub>' and 'NT<sub>3</sub>'. The three categories were

1. Upto Class X (low educated youth)
2. Upto Class XII (medium educated youth)
3. Upto graduation and above (high educated youth).

To study the preferential choice of the youth regarding entrepreneurship-oriented vocations, an interview schedule consisting of a total of 28 different vocations was prepared by the researchers. The usefulness of the vocations or the preferential choices of the youth regarding these vocations was weighed on a three-point scale. These points were marked as most useful, useful and least useful along with their respective scores of three, two and one.

The required data for the study were collected with the help of face-to-face interview technique. The collected information was transferred to the tally sheets, processed and tabulated as per requirement. The mean scores of each profession were accounted and ranked accordingly. Rank correlation coefficient was also used to ascertain the similarities and variations in ranking or prioritization of the vocations.

## Findings

A close examination of Table 1 reveals that 'r' values 0.828, 0.762, 0.843 and 0.920 are highly significant at one per cent level in all the cases. Hence, the null hypothesis 'the vocational courses suggested by the tribal and non-tribal educated rural youth for incorporation while developing a need-based vocational curriculum may not be the same' was rejected and an alternative hypothesis was accepted.

It means that there had been a highly significant association in the ranking pattern or suggestions of tribal and non-tribal youth as a whole with reference to entrepreneurship-oriented vocations to be included for developing a course curriculum in the future. The prioritization pattern of various entrepreneurial vocations (courses) was not found to be independent in other pairs of tribal and non-tribal youth. All of the pairs of groups of tribal and non-tribal youth had a similar pattern of assignment of ranks to different entrepreneurship-oriented courses.

The first five top-preference entrepreneurship courses as suggested by the tribal youth were

1. Electricity wiring
2. Motor rewinding
3. Embroidery
4. Welding practices, and
5. Knitting technology.

These were ranked as one, two, three, four, and five, respectively. The least preferred course or vocation was sculpture.

TABLE 1  
 Preferential Choice of Youth Regarding Entrepreneurship-oriented Vocations to be Incorporated  
 in Developing Employment-generating Course Curriculum

	Mean Score																	
	Tribal									Non-tribal								
	T <sub>1</sub>			T <sub>2</sub>			T <sub>3</sub>			Overall			NT <sub>1</sub>			NT <sub>2</sub>		
	N=40	MS	R	N=95	MS	R	N=40	MS	R	N=175	MS	R	N=59	MS	R	N=73	MS	R
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
1. Repair and maintenance of electrical domestic appliances		2.60	17	2.80	9.5	2.80	9.5	2.75	13	2.67	15.5	2.36	14	2.65	15	2.56	13	
2. Repair and maintenance of radio and TV receivers		2.77	10	2.87	3.5	2.82	6.5	2.84	7.5	2.86	8.5	2.56	3.5	2.83	4	2.73	4	
3. Textiles designing		2.20	26	2.34	27	2.45	25	2.33	27	2.23	27	2.19	19	2.11	27	2.17	25.5	
4. Photography		2.67	15	2.87	3.5	2.77	11.5	2.80	9.5	2.88	6.5	2.50	7	2.67	13.5	2.67	7.5	
5. Hosiery enterprises		2.45	23	2.65	15	2.55	19.5	2.58	17	2.32	25	2.17	21	2.39	21	2.29	22	
6. Sculpture art		1.95	28	2.03	28	2.40	27.5	2.09	28	1.88	28	1.76	28	2.04	28	1.89	28	
7. Baking and confectionery		2.27	25	2.43	25	2.45	25	2.40	25.5	2.28	2.5	2.10	24.5	2.27	24.5	2.21	24	
8. Weaving technology		2.72	13	2.71	14	2.65	16	2.70	14	2.79	11.5	2.38	12.5	2.67	13.5	2.61	12	
9. Automobiles		2.97	1	2.80	9.5	2.82	6.5	2.84	7.5	2.91	4.5	2.61	2	2.79	6.5	2.17	25.5	
10. Dyeing and laundry		2.60	17	2.46	22.5	2.57	18	2.52	21	2.47	21	2.17	21	2.30	22	2.31	20.5	
11. Tourism and travels		2.42	24	2.47	21	2.40	27.5	2.44	23.5	2.54	19.5	2.20	18	2.57	19	2.41	17	
12. Repairing of air-conditioning and refrigeration		2.85	7.5	2.74	13	2.80	9.5	2.78	12	2.77	13	2.47	8	2.79	6.5	2.61	7.5	
13. Embroidery		2.95	3	2.86	6	2.82	6.5	2.87	3	2.79	11.5	2.39	11	2.69	11.5	2.62	11	
14. Printing and book-binding		2.55	19.5	2.53	19.5	2.55	19.5	2.54	20	2.35	23	2.17	21	2.41	20	2.31	20.5	
15. Electrical wiring		2.95	3	2.88	1.5	2.85	4	2.89	1	2.94	2	2.64	1	2.90	2	2.82	2	
16. Clock and watch repair technology		2.80	9	2.86	6	2.90	2	2.85	6	2.86	8.5	2.52	5.5	2.86	3	2.74	3	
17. Drawing and painting		2.72	13	2.62	17	2.70	15	2.66	16	2.67	15.5	2.23	16.5	2.53	18	2.47	15.5	

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
18.	Welding practice	2.90	6	2.88	1.5	2.77	11.5	2.86	4.5	2.84	10	2.35	15	2.72	9.5	2.63	9.5
19.	Plumbing and sanitary fitting	2.17	27	2.46	22.5	2.50	22.5	2.40	25.5	2.32	25	2.10	24.5	2.34	23	2.25	23
20	Garment making	2.85	7.5	2.78	11	2.75	13	2.79	11	2.93	3	2.52	5.5	2.69	11.5	2.71	5
21	Missionary work	2.55	19.5	2.53	19.5	2.62	17	2.56	18	2.39	22	2.38	12.5	2.58	17	2.51	14
22	Plastic materials and products	2.50	21	2.38	26	2.52	21	2.44	23.5	2.32	25	1.94	27	2.18	26	2.14	27
23	Woodwork	2.47	22	2.45	24	2.50	22.5	2.46	22	2.54	19.5	2.06	26	2.48	20	2.36	18
24	Rural engineering technology	2.72	13	2.77	12	2.92	1	2.80	9.5	2.74	14	2.43	10	2.74	8	2.63	9.5
25.	Manufacturing of sports goods	2.75	11	2.64	16	2.72	14	2.68	15	2.59	17	2.23	16.5	2.60	16	2.47	15.5
26	Knitting technology	2.95	3	2.81	8	2.82	6.5	2.86	4.5	2.91	4.5	2.46	9	2.72	9.5	2.69	6
27.	Blacksmithy	2.60	17	2.57	18	2.45	25	2.55	19	2.55	18	2.15	23	2.27	24.5	2.32	19
28	Motor rewinding	2.92	5	2.86	6	2.87	3	2.88	2	3.00	1	2.56	3.5	2.95	1	2.83	1

't' Values

$T_1$  v/s  $NT_1$

0.762\*

$T_2$  v/s  $NT_2$

0.843\*

$T_3$  v/s  $NT_3$

0.920\*

Overall  $T$  v/s  $NT$

0.828\*

\* = Significant at 1 per cent level

MS = Mean score

R = Rank

In accordance with the preferential choice of non-tribal educated rural youth as a whole, the following five were the most preferred courses for inclusion in the vocationalized courses.

1. Motor rewinding
2. Electrical wiring
3. Clock/watch repair technology
4. Repair and maintenance of radio and T.V. receivers, and
5. Garment making.

The least important course in case of non-tribals' suggestions was recorded as "sculpture".

It is worth noting that neither of the groups of tribal and non-tribal youth liked sculpture to be included in the vocationalized curriculum.

The findings of the present investigation are in conformity with the views of Bhargava (1987) who in his article, 'An Overview of Science-based Vocational Courses', expressed the opinion that implementation of the scheme of vocational courses in the right spirit could bring about a change of attitude among common people and would bridge the gap between knowledge and the world of work.

Govindarao (1987) has rightly stated that the scheme is as good as its implementation. It depended entirely upon how the scheme was perceived at the planning, organizing and supervising levels. Undoubtedly, these functions are to be performed at the highest level of the state government. Unlike in general education, professional

expertise in vocational areas is a must for shouldering the expected responsibilities with competence.

John (1987) states that the vocational higher secondary education with particular reference to Kerala State is better than the academic degree courses conducted by the universities. Only 50 per cent of those who complete the pre-degree courses sometimes discontinue their studies and try to seek employment without any training. At the same time, those who complete the vocational higher secondary course have acquired some skills relating to a vocation and can get a wage employment or engage in self-employment for their career. Moreover, those who are eligible can undergo higher studies in the degree courses like their counterparts in the pre-degree course.

### Recommendations

Based on the findings, it is suggested that the entrepreneurial course or vocations which are most preferred by different categories of tribal and non-tribal educated rural youth must be incorporated in the syllabi of school education (10+2). The vocations which are suggested for inclusion in the course curriculum by both the types of respondents are

1. Motor rewinding
2. Electricity wiring
3. Clock and watch repair technology
4. Repair and maintenance of radio and T.V. receivers
5. Garment making

6. Embroidery
7. Welding practices, and
8. Knitting technology.

The course on sculpture may not be included in the syllabi as it was least preferred by the youth. Definitely, if the above mentioned entrepreneurship-oriented courses are incorporated in the school level syllabus,

they would help in eradicating the unemployment problem among tribal and non-tribal educated rural youth. Other courses as per the preferences of different categories of youth may also be considered for the vocationalized syllabus in order to generate better employment opportunities for the youth. <sup>44</sup>

# Implications of Multiculturalism for Education

## The Canadian Context

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### *Abstract*

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*Multiculturalism fosters a society and a Canadian identity in which ethnic, racial, religious and linguistic similarities and differences are valued and respected. The present article deals with the rationale of multiculturalism in Canada, its implications for education and teaching strategies and the role of the teacher in multicultural classrooms. It concludes with a critical look at multiculturalism in Canada.*

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**C**ANADA is the largest country in the Western Hemisphere and the second largest, next to Russia, in the world, with a total area of about 10 million square kilometres. Within this vast expanse, Canada, with a diverse population of 30 million, is divided into ten provinces and three territories. The parliamentary system based on the British constitutional model is the form of government in Canada. The British monarch is still the Head of State represented by the Governor General. Economy is traditionally based on natural resources (forest covers 44 per cent of land area) and agriculture (the world's second largest exporter of wheat) with major industrial development in Ontario and Quebec. Multiculturalism within a bilingual framework (English and French) recognizes that cultural pluralism is the very essence of Canadian identity. Canada is truly a mosaic of cultures as Canada has about one hundred ethnic groups, and every ethnic group has the right to preserve and develop its culture and values within a Canadian context.

Multiculturalism embodies the following concepts—living together in one society, different ethnic, cultural, racial, linguistic, religious and economic groups, and the recognition that all these diverse groups are equal.

Three definitions of multiculturalism are extracted from the above statement.

(i) It is to accept, tolerate, respect and

appreciate diversity. It is the recognition of the ethnic, cultural, racial, linguistic and religious diversity that exists in Canada.

(ii) Multiculturalism is a policy adopted by the government in response to the Royal Commission on Bilingualism and Biculturalism (1971).

(iii) Multiculturalism expresses a social goal. It seeks a society and a Canadian identity in which all are accepted and people's differences are *valued* and *respected*.

According to McLeod (1986) the following seven principles are inherent in multiculturalism.

- Equality of status of all cultural and ethnic groups within the framework of our official bilingual country.
- Freedom of all individuals as well as groups to the retention and development of their cultures as part of Canadian identity.
- Equality of access by all individuals and groups to employment and promotion, services and support.
- A commitment to sharing our cultures within the mainstream of Canadian society.
- An undertaking to participate in Canadian citizenship and the democratic process in terms of both rights and responsibilities.
- A belief that individuals have the freedom to choose the particular cultural attributes they prefer within the frame-

work of our democratic principles.

- Respect for observance of human rights and civil liberties are exemplified in the Canadian Charter of Rights and Freedoms, the common law, and human rights codes at federal and provincial levels. (McLeod, 1986)

Multiculturalism includes all Canadians, and it is for all Canadians. In essence, the above principles on which multiculturalism is based has helped to clarify the inclusive and comprehensive, yet dynamic nature of multiculturalism in Canada. One significant reaction to the policy of multiculturalism was from the Native Peoples of Canada. They rejected the concept outright as they simply saw themselves as people with aboriginal rights beyond the sphere of multiculturalism.

Multiculturalism ideology and cultural diversity, and willingness to tolerate the retention and expression of ethnicity are considered by most people to be an asset for Canada. Commitment to the maintenance of basic human rights and fundamental freedoms provides a natural reinforcement of this ideology. "Our commitment to cultural diversity and our respect for the rights of minorities evokes all that is best in the Canadian tradition. Real unity accepts dissent and rejoices in the diversity of its people." (Shymko, 1980)

### History of Multiculturalism

Canada has always been an ethnically heterogeneous country. Before the arrival of the

Europeans, natives of what is now Canada constituted about fifty societies belonging to a dozen linguistic groups. The French arrived in the sixteenth and seventeenth centuries. The Metis, another distinct ethnic group, emerged as a result of interbreeding between the French and the Indian. The British—English, Irish, Welsh and Scottish—began arriving in Canada and soon after some Germans and Dutch came. In the later part of the nineteenth century the immigrants came from all parts of Europe and parts of Asia. Since the nineteen sixties immigrants have come from all of Asia, Africa and South America as well.

In 1963 the federal government appointed the Royal Commission on Bilingualism and Biculturalism to inquire into and report upon the existing state of bilingualism and biculturalism in Canada and to recommend what steps should be taken to develop the Canadian Confederation on the basis of an equal partnership between the two founding races (English and French). In 1965 the Royal Commission made numerous recommendations concerning linguistic policy, education, the world of work and the federal capital. The Royal Commission took into account the contribution made by the other ethnic groups to the cultural enrichment of Canada, and later on recommended measures to safeguard that contribution. But multiculturalism, as a policy, was not introduced until 1971. The then Prime Minister, Pierre Trudeau, stated that the policy

was designed to preserve human rights, develop Canadian identity, strengthen citizenship, reinforce Canadian unity, and encourage cultural diversification within a bilingual framework—English and French.

In 1972, a Minister of State for Multiculturalism was appointed and a year later, the Department of the Secretary of State started the federal Multicultural Grants Programme and established the advisory body—Canadian Multiculturalism Council—to help the Minister implement the policy. A milestone was reached in 1982 when multiculturalism, along with equality rights, was enshrined in the Constitution Act as part of the Canadian Charter of Rights and Freedoms. The focus of the Multicultural Act of 1988 was mainly on equality measures for all Canadians. Out of its nine principles, eight deal with equity issues; only the ninth refers to cul-

ture. In 1989, a full multicultural ministry was established.

A main problem with the federal multicultural policy is in its implementation in education, which is a provincial responsibility according to the Canadian Constitution. Most provinces have given some attention to the development of a multicultural education policy. But there are some considerable variations of provincial policies toward multicultural education.

### **Rationale for Multiculturalism**

In an increasingly multicultural and globally interdependent world, and fast changing society, learning to value diversity and learning to be comfortable with diversity (multiculturalism) become curriculum imperatives. The rationale for multiculturalism is given below.

#### **Rationale for Multiculturalism**

- A democracy is qualitatively better the more it is able to accept and respect the rights of the minorities
- Ethnicity is a power within Canada brought about by population changes. In 1867 seven per cent of the people were other than English or French in Canada, today about 33 per cent are other than English or French
- Immigration policy changes in the last five decades have brought more non-Europeans. Canada needs immigrants if we want to maintain current population levels.
- Urbanization has concentrated many multicultural groups in large cities — Toronto and Vancouver.
- An active social policy of multiculturalism followed by various governments in the last three decades.
- There is a tendency for people to be with people like themselves.
- The host culture must accommodate some aspect — culturally and legally viable.
- Ethnic-cultural literacy is required for all students in Canada.

- It promotes the full and equal participation of individuals and communities of all origins in all aspects of Canadian society.
- Every Canadian has the freedom to choose, to enjoy, enhance, and share his/her heritage
- The Government of Canada encourages and assists the social, cultural, economic and political institutions to be both respectful and inclusive of Canada's multicultural character.
- Multiculturalism provides an opportunity to enrich society by providing novel ways to view events, to solve problems and to view relationships with the environment.
- A multicultural curriculum, which reflects the cultures, values and goals of the groups within a nation contributes significantly to the development of healthy nationalism and a national identity.

### Implications of Multiculturalism for Education

Although the policy of multiculturalism was officially declared in 1971, it was already a *fait accompli* in Canadian society as the history of Canada indicates that multicultural interactions have traditionally taken place as a part of life in Canada. Therefore, to deal with reality, wherever people live "multiculturalism is everyday life in Canada". For educators this means that, if education is to prepare students for living then we must prepare students for multicultural living in Canada, if the education we provide is to be relevant, culturally responsive, and satisfying to those we educate.

The primary concern of multiculturalism is the recognition of cultural diversity and the development of individual capacity to function effectively in a multicultural society. This requires the educational systems to use cross-cultural teaching and learning to facilitate intercultural understanding and collaborative interdependence. Moreover, multiculturalism brings useful insights from ethnicity and

culture, tradition and change, and different histories and heritages. It incorporates human concerns at the local, national, and global levels into one framework and includes cognitive, affective and ethical dimensions relevant to education.

Effective teaching about multiculturalism can best take place within an educational setting that accepts, encourages, and respects the expression of multicultural and racial diversity. To attain this kind of educational milieu, the total school environment must be reformed, not merely courses and programmes. To permeate the total school environment with multiculturalism, it is necessary to have : a curriculum which reflects the ethnic learning styles of the students within the school community, provides students with continuous opportunities to develop a better sense of self, and self pride, helps students understand totality of experiences of multicultural groups, promotes values, attitudes and behaviours that support multiculturalism, helps students develop their decision-making abilities, social-

participation skills, effective interpersonal and interethnic group interaction, helps students to view and interpret events and situations from multicultural perspective and points of view, and provides resource materials on the diverse aspects of the histories and cultures of multicultural groups.

Multiculturalism has not only become an educational imperative of the future in Canada, but it has also significantly impacted every aspect of education including the curriculum, as given above, teaching strategies, the role of the teacher, teacher education, total school environment and inservice education of teachers and support staff. A couple of these topics

are sampled in the following pages.

### Teaching Strategies

Teachers need a good reserve of teaching strategies when they are dealing with multiculturalism and the multicultural child in the classroom. The decision-making models consisting of social science inquiry, value inquiry and the synthesis of knowledge and values, and reflective decision-making and social action are utilized. Various strategies are particularly conducive to liberating pedagogy while also serving the objectives of multiculturalism (Ghosh, 1998). The characteristics of such teaching strategies are given below.

#### Characteristics of Teaching Strategies for Multiculturalism

- Strategies which allow for interaction and greater student involvement in sports.
- A variety of strategies for successful pedagogy
- Strategies to break communication barriers
- Skill-development through inquiry issues.
- Small group strategies to build confidence
- Value-clarification strategies to sort out conflicting values
- Strategies oriented towards action rather than task as culturally different students respond better to action than to task.
- Community-oriented strategies with heavy parent involvement in field trips, and as guest speakers.
- Student-specific pedagogy (Learning Style - Informed Teaching).
- Self-esteem-oriented strategies.
- Tolerance/Anti-racism-oriented teaching
- Gender-fair strategies.
- Cooperative learning strategies
- Strategies which teach decision-making and social-action skills
- Teaching strategies that take into account students who are different
- Strategies that focus on involving student experiences, developing positive identity, critical thinking and empowerment.

## The Role of the Teacher

It is well known that teachers are the single most significant variables in the teaching-learning process. The role of the teacher in a multicultural classroom is enlisted in the following box.

conceptualization in dealing with its critics and with the new ethnic composition of the population of Canada. Along with that, another aspect of the problem in defining multiculturalism is the assumption that multiculturalism is defined by race

### The Role of the Teacher

- Needs commitment and enthusiasm to convey the concepts of multiculturalism to students.
- Needs ability to analyze one's own biases and develop procedures that are fair and just for students.
- Helps individual students develop positive attitude towards themselves and others
- Recognizes the difference in students in experiences, cultures, lifestyles as well as in terms of gender, ethnicity, race and the social context that shapes their individual development
- Recognizes the effects of the hidden curriculum and analyzes unconscious stereotypes and biases.
- Creates a classroom environment that is conducive to intergroup sensitivity, understanding, interaction and respect.
- Becomes aware of, respects and values students from all cultural, socio-economic, ethnic and language backgrounds.
- Plans and implements culturally responsive instruction based on students' needs and provides culturally sensitive classroom management.
- Seeks out multiple strategies, approaches, materials and resources for meeting diverse student needs.
- Develops the ability in reflection, evaluation, analysis and self-monitoring of one's teaching in the multicultural classroom.
- Believes in his/her ability as a teacher to make a difference and convince students that they will learn.
- Views himself/herself as an educator who welcomes, adapts, nurtures and encourages students.
- Creates a learning environment where a student both feels the need to know something and believes he/she has a reasonable chance to succeed. Promotes emotional maturity among the community of learners.
- Strives to work together with students to create a conducive environment by affirming the students' cultural identities.

## Multiculturalism through the Critical Eye

The policy of multiculturalism with a bilingual framework is handicapped by its name and by its ambiguous

(McIntyre, 1997). This assumption is erroneous in that not all white people came from the northwest European background with its specific value system. It is often

erroneously assumed that all Europeans have a common heritage and history; this is far from being true.

Another problem lies in the fact that people define multiculturalism differently depending on their frame of reference. On one hand, multiculturalism should be part of the social studies curriculum in school and on the other hand multiculturalism should take the form of a structured, anti-racist curriculum. If we cannot agree on the definition, it becomes difficult to create the educational foundation and theory to teach it.

It is considered by a few critics that ethnic diversity can weaken a society by creating too much separateness. If ethnic groups were geographically concentrated, residentially isolated, educationally segregated, and economically and politically unequal, and if new-comers were not encouraged to learn an official language then Canada as a whole would be weakened. But on the other hand, Canadian multiculturalism emphasizes equality and integration of immigrants and does not encourage ethnic groups to "set up institutional systems that could minimize their contact with other Canadians" (Burnet, 1976). It is essential that a multicultural society continually balance the degree of separateness necessary for group survival with the degree of integration necessary for equality and identification with the society as a whole.

A few Canadians feel that multi-

culturalism is just another "vote-buying ploy". Paul Jackson in his column in *The Star Phoenix* writes

Let's be honest here. Diversity isn't strength, it's weakness. All great nations have a common soul and a common purpose. Just ask the Japanese how much multiculturalism they allow. Ask Quebec—Quebeckers feel it is a threat to their identity. As for new immigrants needing to adjust, tell that to the Ukrainians, Greeks, Germans and Chinese who came here decades ago. They didn't get any handouts from the tax payers, yet they prospered and maintained their own languages and traditions.

Critics of multiculturalism see it as one more divisive force in a society already fragmented along linguistic, cultural and regional lines. Bissoondath (1994) sees official multiculturalism as encouraging "exoticism" citing examples that when he came to Canada from Trinidad to attend York University he was advised "to stick with his own" and when he entered the university cafeteria, he found unofficially designated tables for different racial and cultural groups. However, Bissoondath is not against ethnic groups retaining their cultures when they come to Canada, as long as they accept the fact that they are Canadians and not hyphenated Canadians.

Sometimes, when people refer to themselves as Italians or Chinese-Canadians (hyphenated Canadians), it seems that the people are identifying themselves with the culture, heritage of

Italians or Chinese not with Italy or China as a state, and as a consequence, have less loyalty to Canada. But it should be clarified that cultural identity is not the same thing as political allegiance to a country. Ethnic loyalties usually do not, and should not detract from wider loyalties to the country. On the other hand, this concern about divided loyalties exists due to semantic confusion. Northrop Frye makes the distinction between uniformity and unity. In a uniform society everyone would think and act alike; diversity would not exist. Unity "tolerates dissent and rejoices in variety of outlook and tradition, recognizes that it is man's destiny to unite and not divide" (Frye, 1971). In other words, the critics who talk of multiculturalism as a threat to national unity really mean national uniformity. Multiculturalism, of course, does threaten national uniformity.

Another critical point raised by many Canadians is the funding of projects dealing with multiculturalism and heritage languages. If the immigrants want to retain their language and cultures they should pay for language and heritage instruction on their own and "not one cent of federal, provincial, or municipal government money should be devoted to fostering the retention of their cultures" (Granatstein, 1998). However, the government should spend limited funds on helping the new immigrants to adapt to Canadian society by teaching them the basic knowledge, the

symbols, the basic Canadian values and means of communication. But the current multiculturalism policies and use of government funds to promote such

Separateness is not only a shameless waste of tax dollars—one undertaken for partisan political, not national, advantage—but a terrible squandering of human resources. Even worse, the policies of multiculturalism have created the idea among immigrants (and even among native born citizens, especially in francophone Quebec) that Canada, and in particular English-speaking Canada, has no culture and no nationality of its own. If it did, they ask with some justification, why should the government not try to show it to them? Why else would it fund newcomers to preserve their old ways? (Granatstein, 1998)

A number of Canadians, especially those who are on the political right, are disturbed by the demands being made by ethnic groups. A poll conducted by the federal government found that four in ten Canadians believed that there are too many members of visible minorities in Canada. Another Decima Research poll conducted in 1994 showed that 72 per cent of Canadians surveyed thought that ethnic or racial groups should adapt to a Canadian value system rather than maintain their own. A significant minority (41 per cent) agreed with the statement: "I am tired of ethnic minorities being given special treatment" (McConaghy, 1995). Similarly, in October 1996, Heritage Canada released



a report on multiculturalism that found public dissatisfaction with the concept (Granatstein, 1998).

Another argument advanced by the critics of multiculturalism is that it is diluting Canadian history and identity "as the teachers at one high school said, the pressure is on to teach everyone's history but our own" (Granatstein, 1998). Through the misguided multicultural policy they are trying "to make everyone feel good." The apparent emphasis on multiculturalism and anti-racism has reduced history to "a treasure-trove of incidents and examples which were used to illuminate some present concern". In the words of Ken Osborne, "history disappeared as a course, to be replaced by a kind of mini-anthropology of Canada's constituent cultures. Multiculturalism painted Canada as a community of communities but its emphasis was on the plural rather than the singular... the final result was usually a series of discrete but mutually isolated heritages, united only by being located in the same political unit" (quoted by Granatstein, 1998).

Canada seems to suffer from a historical psychosis because there was racism in Canada (there still is!). There are a number of examples of racism in the past such as Blacks were refused entry on the basis of ethnicity, Blacks worked as slaves in Canada in the nineteenth century, Canada refused entry to Jews during the Nazi

regime, and Ukrainian Canadians, Italian Canadians, and Japanese Canadians were interned by the federal government during the two world wars. Under the effect of this psychosis, "Canadians try to demonstrate to themselves and the world that we are a deeply racist society. The past must be destroyed in toto so that we can build a new, perfect, multicultural society with the new core Canadian values predominant" (Granatstein, 1998). The neglect of teaching Canadian history, incredible influence of American culture through the media make Gad Horowitz lament: "Multiculturalism is the masochistic celebration of Canadian nothingness" (quoted by Granatstein, 1998).

Despite the criticism of Canada's multiculturalism, its defenders believe that Canada's multiculturalism can survive and strengthen the fabric of the nation. If Canada survives as a nation, the Canadian experience in multiculturalism can become a model for other nations to emulate. Jean Chretien, the Prime Minister of Canada emphasized the same point that Canadians are well placed to survive in the era of globalization where more cooperation is required: "The values that we have developed for tolerance and diversity and the capacity for sharing—this is what is needed around the world. And, more and more, the Canadian model will be used to keep countries and regions together around the world" (Taber, 1999).

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# Parents' Opinions on Prevailing Practices in Preschool Education

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## ***Abstract***

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*Policies and programmes regarding Early Childhood Education are topics of frequent discussion and debate. Typically, arguments favour a humanistic and non-mechanistic approach for all-round development of these young children. This study attempts to elicit parents' opinions on various problems and practices in contemporary preschool education systems, and to explore any trends in relation to specific respondent variables.*

*By using a 25-item Parental Attitude Questionnaire on Early Childhood Education exclusively prepared for the purpose of this study, it was found that most contemporary parents were in a confused and uncertain mental state. The study highlights the need to crystallize parents' opinions firmly either in favour of or against prevailing practices in preschool education. The findings are presented and discussed for the betterment of preschool children.*

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**T**HE need and compulsion to leave even children below three years to the formal care of creches, nurseries, kindergartens, or play-schools is being increasingly felt by most parents in contemporary society. The prevalence of this predicament may be due to increased pre-occupation of parents with their own lives or it could also be the consequence of their justified apprehension that their children would be left behind in the ongoing race under the euphemism of preschool education.

Several rounds of policies and programmes on Early Childhood Education (ECE) are being debated. Typically, arguments focus on the need to evolve a humanistic and non-mechanistic approach for the all-round development of these young children. Many supplications have sought to reduce the formal academic or bookish loads on preschool children and to wean them away from cramped classrooms to natural learning situations (Saini and Chhikara, 1993; Venkatesan, 1994).

While discussions and deliberations rage among the enlightened few, the ground realities appear to be grimly contrasting. In a related study on the status of contemporary curriculum at preschool levels, it was reported that 25 to 75 per cent of the sample institutions laid routine emphasis on acquisition of academic skills like alphabet recognition, reading, writing, dictation, grammar, addition, subtraction, etc., even for children below five years. The practice of

holding admission tests and allied pressure-provoking practices like giving daily home work, insistence on formal evaluations by way of examinations/class tests, use of different teachers for 'teaching' different 'subjects', following a regimen of time table for teaching various subjects, maintenance of formal classroom settings, etc., were reported in more than half of the sample preschools surveyed (Lalitha and Suhasini, 1993).

While the teachers, in particular, and the broader preschool educational rubric, in general, may be blemished on one side for the prevailing state of affairs, on the other side, parents are equally guilty patrons of these practices being perpetuated in the prevailing preschool systems. It was the aim of this study to elicit opinions of parents on various problems and practices in contemporary preschool education systems, and to explore any trends in relation to specific respondent variables like sex, education, educational qualifications and number of children.

### Method

The study was conducted by drawing sample parents (N: 156) from the twin cities of Hyderabad and Secunderabad. The sample included 96 male respondents (fathers) and 60 female respondents (mothers) of preschool children with mean age of 34 years (SD:5.05). Among the parents were postgraduates or above (N: 60), graduates (N: 48) and undergraduates (N: 48).

## Procedure

The procedure of data collection involved use of a twenty-five item Parental Attitude Questionnaire on Early Childhood Education (PAQ-ECE) exclusively prepared for the purpose of this study. Each item in PAQ-ECE was to be responded along a five-point Likert-type of rating scale, viz., strongly agree, agree, cannot say, disagree and strongly disagree. An inhouse two-week test-retest reliability check for PAQ-ECE on a sub-sample (N: 42) showed a correlation coefficient of 0.83. The face validity for the Questionnaire was also high.

The direction of individual items in PAQ-ECE was considered before giving appropriate weighted scores from one to five points. A high score on PAQ-ECE indicated positive valence and a low score indicated negative valence in parent opinions. The maximum possible numerical score reflecting positive valence of respondents' opinion on ECE in this Questionnaire is 125. Data was collected, compiled and computed for descriptive and interpretative statistical inferences by using SPSS/PC Version 3.0 (Nornsis, 1989).

## Results and Discussion

For the overall sample (N: 156), it is seen that parents maintain a generally positive directional valence in their opinions towards preschool education (Mean: 79.08; SD: 7.20). On an average, mothers show greater positive directional valence in their opinions on ECE (N:60; Mean: 81.30; SD: 8.03) than fathers (N: 96; Mean : 77.60; SD: 6.24) in this study ( $p < 0.05$ ).

With regard to education variable, respondents with postgraduation or above qualification (N: 60; Mean: 81.10; SD: 7.18) show higher positive valence in their opinions towards ECE followed by undergraduates (N: 48; Mean: 78.63; SD: 2.64) and then graduates (N: 48; Mean: 76.25; SD: 8.48). Thus, education appears to be influential in determining the favourable/unfavourable direction of respondent opinions towards contemporary practices in preschool education ( $p < 0.05$ ). The influence of number of children on parents' opinions towards ECE does not appear a significant variable ( $p > 0.05$ ) (Table 1).

TABLE 1  
Mean and SD Scores on PAQ-ECE in Terms of Various Sub-samples

Variable	N	Mean	SD	Probability
Overall	156	79.08	7.20	
Sex				
Male	96	77.69	6.24	t:3.142
Female	60	81.30	8.03	p:<0.01, (HS)
Education				
Undergraduates	48	78.63	2.64	t:1.857
Graduates	48	76.25	8.48	p:>0.05; (NS)

Graduates	48	76.25	8.48	t: 3.231
Postgraduates	60	81.10	7.18	p: <0.001; (HS)
Undergraduates	48	78.63	2.64	t: 2.282
Postgraduates	60	81.10	7.18	p: <0.01; (S)
<i>Number of Children</i>				
One	36	78.33	3.99	t: 0.552
Two	84	79.07	7.59	p: >0.05; (NS)
One	36	78.33	3.99	t: 0.117
Three or more	36	78.50	7.72	p: >0.05; (NS)
Two	84	79.07	7.59	t: 0.315
Three or more	36	78.50	7.72	p: >0.05; (NS)

An item-wise analysis of the distribution of weighted ranks (Table 2) shows a skew in favour of a greater number of rank IV (N: 960; 24.62 per cent), rank V (N: 732; 18.77 per cent), rank I (N: 570; 14.62 per cent) and rank III (N: 402; 10.30 per cent) respectively.

TABLE 2  
Item-wise Distribution of Frequency and Weighted Ranks on PAQ-ECE

Items	Ranks										Total
	I		II		III		IV		V		
	N	WR	N	WR	N	WR	N	WR	N	WR	
1.	84	53.9	60	38.5	—	—	6	3.9	6	3.9	156
2.	6	3.9	36	23.1	24	15.4	72	46.2	18	11.5	156
3.	12	7.7	54	34.6	18	11.5	36	23.1	36	23.1	156
4.	42	26.9	6	3.9	—	—	66	42.3	42	26.9	156
5.	36	23.1	78	50.0	—	—	24	15.4	18	11.5	156
6.	48	30.8	72	46.2	12	7.7	18	11.5	6	3.9	156
7.	24	15.4	42	26.9	30	19.2	36	23.1	24	15.4	156
8.	30	19.2	72	46.2	30	19.2	24	15.4	—	—	156
9.	42	26.9	42	26.9	6	3.9	54	34.6	12	42.3	156
10.	—	—	72	66.2	48	30.8	36	23.1	—	—	156
11.	6	3.9	60	38.5	36	23.1	54	34.6	—	—	156
12.	18	11.5	42	26.9	18	11.5	66	42.3	12	42.3	156
13.	—	—	12	7.7	18	11.5	78	50.0	48	30.8	156
14.	—	—	24	7.7	6	3.9	60	38.5	78	50.0	156
15.	12	7.7	24	15.4	6	3.9	84	53.9	30	19.2	156
16.	12	7.7	72	15.4	6	3.9	84	53.9	30	19.2	156
17.	36	23.1	72	46.2	12	7.7	30	19.2	6	3.9	156
18.	42	26.9	72	46.2	6	3.9	36	23.1	—	—	156

19	6	3.9	24	15.4	60	38.5	48	30.8	18	11.5	156
20	12	7.7	18	11.6	30	19.2	60	38.5	36	23.1	156
21	72	46.2	30	19.2	6	3.9	36	23.1	12	7.7	156
22	6	3.9	12	7.7	18	11.6	72	46.2	48	30.8	156
23	6	3.9	6	3.9	—	—	66	42.3	78	50.0	156
24	6	3.9	—	—	—	—	60	38.5	90	57.7	156
25	12	7.7	18	11.9	12	7.7	30	19.2	84	53.9	156
Total	570	14.6	960	24.6	402	10.3	1236	31.6	732	18.8	3900

WR—Weighted Ranks

The qualitative variations in parent opinions towards current practices in ECE are further clarified in statement-wise distribution of mean and SD scores for overall sample (Table 3).

The respondents are unequivocal in expressing their need for preschool institutions (Item 1, Mean: 1.7; SD: 1.0) even for children below five years. However, they feel that there must be legal sanctions

TABLE 3  
Item Analysis of Responses on PAQ-ECE

S.No	Items	Mean	SD
1.	There is urgent need for preschool institutions	1.7	1.0
2.	Prefer structured/syllabus-bound programme concentrating on acquisition of academic skills.	3.4	1.1
3.	Prefer teacher-centred programme requiring the singular role of teachers.	2.7	1.2
4.	Entrance tests/examinations are best screening measures for entry into preschools.	3.1	1.1
5.	Regular and compulsory home-work required for drilling in academic skills	2.4	0.9
6.	Competition is the best way to ameliorate better achievements.	2.1	1.1
7.	Comparison of poorly performing child against better ones enhances their levels of performance.	3.0	1.3
8.	Teachers inculcate/demand perfection so that the same trend continues throughout their lives.	2.3	1.0
9.	Problem behaviours in children are due to their natural propensity to misbehave.	2.7	1.4
10.	Problem behaviours reflect their deliberate or intentional will to control teachers/parents.	2.8	0.8
11.	Best way to manage problem behaviours is to yield to their demands.	4.1	0.9
12.	Preschool children pressurized early learn or pick up faster than at later ages.	3.1	1.2
13.	Admit inadequacy in child-rearing skills.	4.0	0.5
14.	Legal sanctions on minimum age limits of entry for preschool children needed	4.3	0.9
15.	It is not unnatural for parents to expect their children to fulfill the ideals which they themselves could not achieve.	4.1	0.8

16. Too much of play in preschool age will later affect their academic development	4.2	0.5
17. One or more teachers should handle a class of preschool children.	2.4	1.1
18. Strict regime of time table should be followed in preschool classes.	2.2	1.1
19. Availability of minimum physical space should be made mandatory to run preschool programmes.	3.3	1.0
20. Over-stimulation could result in premature loss of interest in academic pursuits.	3.6	1.2
21. Class examinations/tests ought to be conducted periodically.	2.3	1.4
22. It is necessary to purchase costly toys or games for play activities with preschool children.	4.1	0.7
23. Prefer use of playway/activity-based methods for teaching preschool children.	4.3	1.0
24. Combine use of modelling/demonstration to traditional ways of chalk and talk in teaching.	4.5	0.8
25. Teachers should undergo periodic inservice training to sharpen their skills.	4.2	1.6

on the minimum age limit for entry for preschool children (Item 14; Mean: 4.3; SD : 0.9). They strongly agree on the admitted inadequacy of child-rearing skills, both, in themselves as well as in teachers (Item 13; Mean: 4.0; SD: 0.5). This is perceived as one of the primary reasons for most prevailing problems in preschool children. They prefer use of playway/activity-based methods (Item 23; Mean: 4.3; SD: 1.0) combined with modelling/demonstration by way of charts, flash cards, etc., to traditional ways of chalk and talk when teaching these children (Item 24; Mean: 4.5; SD: 0.8). Many parents insist on teachers undergoing periodic inservice training on the latest technology of teaching preschool children (Item 25; Mean: 4.2; SD: 1.6).

Many parents appear to vacillate on several issues pertaining to contemporary practices of rearing preschool children. For example, they are undecided if preschool years constitute the right time to inculcate a spirit

of competition (Item 6; Mean : 2.1; SD: 1.1), pressurize children (Item 12; Mean, 3.1; SD: 1.2) or demand perfection in behavioural performance (Item 8; Mean: 2.3; SD: 1.0). At the same time, they show a lurking fear that overstimulation/over-exposure of these children could even result in premature loss of interest in academic pursuits (Item 20; Mean: 3.6; SD: 1.2).

There is attitude ambivalence with regard to several aspects of prevailing curriculum and teaching practices for preschool children. For example, they are unsure if preschool curriculum should be structured or unstructured (Item 2; Mean: 3.4; SD: 1.1), if one or more teachers should handle a class of preschool children (Item 17; Mean: 2.4; SD: 1.1), whether or not a strict regime of time table is to be followed (Item 18; Mean: 2.2; SD: 1.1) whether availability of minimum physical space should be made mandatory to run preschool programmes (Item 19; Mean: 3.3; SD: 1.0), if class examinations/tests



ought to be conducted periodically (Item 21; Mean: 2.3; SD: 1.4), etc.

It is unfortunate to discover the contemporary parent caught in the quagmire of confusion and conflict about appropriate child-rearing practices for management of behaviour problems in preschool children. Many share stereotype notions like it is 'natural' for children to misbehave (Item 9; Mean: 2.7; SD: 1.4), or that problem behaviours are perpetuated 'deliberately' by preschool children in order to control/embarrass parents/care-givers in front of others (Item 10; Mean: 2.8; SD: 0.8). They naively believe that comparison of a poorly performing child against his /her better performing peer could bring improvements in their children (Item 7; Means: 3.0; SD: 1.3). The attitude content of par-

ents of preschool children in this study is somewhat similar to parents having children with mental handicaps (Peshawaria, Venkatesan and Menon, 1990; Peshawaria and Venkatesan, 1992; Venkatesan and Vepuri, 1992; Venkatesan, 1993).

In sum; the present study highlights the seemingly confused and uncertain mental state of most contemporary parents of preschool children, who are still awaiting a probable outside impetus to crystallize their opinion firmly in favour or against prevailing practices in preschool education. Probably the onus is upon enlightened professionals to aid parents overcome their subjective struggles and facilitate them to formulate a stable constellation of attitudes in a direction that is favourable for the betterment of their preschool children.

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# Problems of First-generation Adolescent Learners

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## **Abstract**

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*The present paper deals with the problems of first-generation learners whose average age is 16+ years, studying in higher secondary classes of +2 level of education. For this purpose a sample (N: 50) of first-generation learners was selected from among the students studying in various intermediate colleges in Farrukhabad District, Uttar Pradesh. Besides the group of first-generation learners, a parallel group (N: 50), matched in relation to age, sex and educational level of non-first-generation learners was also selected. To measure the various problems related to areas like health and physical development, finance, sex and marriage, education, etc. the problem check-list of Joshi and Pandey was used. The findings revealed that the first-generation and non-first-generation learners had differential priorities for the various problems. But on the basis of the Sum of Rank Test, no significant difference in the various areas of problems of the two groups was observed.*

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**A**DOLESCENTS have various problems, one of them being that of maladjustment. The family and its educational and social environment are among the factors creating problems for adolescents. Society is not able to catch up with modernism in its constructive aspects, and its traditions have brought about a conflict of values and created frustration among the youth giving rise to many serious problems. Problems like ill health, lack of finances, violence, etc. are faced by adolescents in some form or the other.

Behavioural problems of adolescents has been a subject of study of Western psychologists, sociologists and educationists for the last so many years. But in India very scanty research work regarding the various problems of the youth is available. The information related to the problems of the youth in western countries may not be applicable to the Indian youth, because of the vast differences in family relationship, socio-economic condition, values, etc. Behavioural expectations of the developed countries of the West and East are vastly different from those prevailing in India.

In India the first-generation learners also have problems like the other disadvantaged groups. This is one of the most disadvantaged groups of Indian society. Illiterate parents, explosion of population, religious rigidity, poor economic conditions, remote village areas and sex discrimination in traditional and orthodox village societies are

the major factors which hinder the development of first-generation learners. Various research studies reveal that home background and cognitive home ability variables have been unfavourable to first-generation learners (Mehta and Mathur, 1986), Mehra and Dhar (1980), Gupta (1994), Gyanani and Gupta (1996), and Agarwal (1998) provide evidence of poor performance in intelligence tests and academic achievements. Huddar and Mrinal (1987) reported that adolescent first-generation learners were less assertive in comparison to non-first-generation learners. Their family background was very poor. Mandal and Sutradhar (1983), Gupta (1994), and Agarwal (1998) confirm that the contribution of the father's educational background was more important than the mother's. In relation to the problems of first-generation learners there are very few studies.

### The Problems

The present investigation was undertaken with the assumption that the adolescent first-generation learners have greater youth problems than the non-first-generation learners. The reason is that adolescence is a period of stress and strain and the adolescent first-generation learners are disadvantaged youths having poor family educational and economical background. Thus they were facing various problems in comparison to non-first-generation adolescent learners.

In the study, first-generation adolescent learners are the adolescents whose generation has gone to school or college for the first time. Their parents, either father or mother has not gone through any formal education upto the primary level or are illiterates. While the non-first-generation learners are those whose parents are educated since the last two or more generations. Presently their parents, either father or mother, or both have more than post-primary education or higher education.

### **Method and Design of the Study**

Ex-post-facto method of research with two matched group research design was followed in the investigation. Besides the group of first-generation learners, a parallel matched group of non-first-generation learners with respect to age, sex and educational level was selected as a control group for comparison purposes.

### **Sample**

The sample of the study consisted of 50 first-generation learners and 50 non-first-generation learners studying in Class XI of various intermediate colleges of Farrukhabad district of U.P. The subjects of the two groups were males belonging to Arts, Commerce and Science streams. The average age of the group of first-generation learners was 16+ years, while the average age of the non-first-generation learners was 15.5+ years.

### **Tools**

The problem check-list of Joshi and

Pandey (1988) was used to study the various problems of the youths. The selected problem check-list consisted of 330 items related to 11 areas viz., Health and Physical Development, Finance, Residence and Employment, Social and Recreation, Sex and Marriage Problems, Personal and Psychological Problems, Moral and Religious, Home and Family, Future Vocation and Education, Adjustment to School Activities and Curriculum and Teaching Methods. According to the test manual, the reliability of the test was determined by test-retest and split half methods which are 0.71 and 0.90 respectively. The factorial and concurrent validity of the test are + 0.023 to -0.40 and 0.29 respectively.

### **Statistical Techniques**

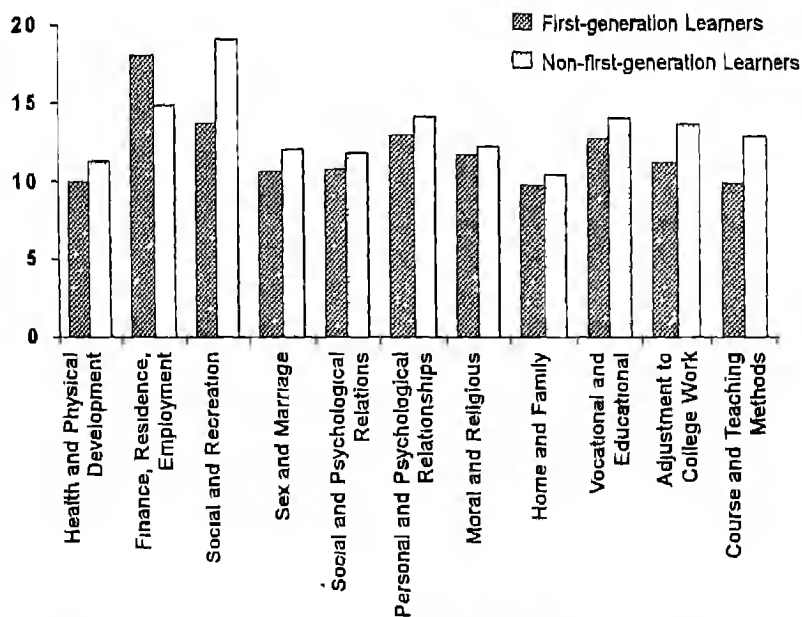
For analysis of the data, the Sum of Rank Test was followed. The reason was that the scores related to various areas of problem check-lists were not found to be normally distributed. Hence, parametric tests of significance were not used.

### **Results**

To know the various dominating problems of the first-generation learners and to compare these with the non-first-generation learners, the mean values of the scores related to eleven areas were computed. On the basis of the mean values ranks were provided to the different problems of the two groups. The results obtained are shown on the next page.

**TABLE 1**  
**Mean Values and Corresponding Ranks of the Various Problems of First-generation and Non-first-generation Learners**

S.No.	Areas of Problem	First-generation Learners		Non-first-generation Learners	
		Mean Values	Ranks	Mean Values	Ranks
1.	Health and Physical Development	9.88	9	11.26	10
2.	Finance, Residence, Employment	18.08	1	14.78	2
3.	Social and Recreation	13.72	2	19.16	1
4.	Sex and Marriage	10.60	8	11.98	8
5.	Social and Psychological Relations	10.72	7	11.80	9
6.	Personal and Psychological Relationships	12.88	3	14.08	3
7.	Moral and Religious	11.62	5	12.16	7
8.	Home and Family	9.72	11	10.30	11
9.	Vocational and Educational	12.64	4	13.96	4
10.	Adjustment to College Work	11.08	6	13.60	5
11.	Course and Teaching Methods	9.76	10	12.80	6
$Z_1 = Z_2 = 1.80$		$P > 0.05$			



**Fig.1 :** Comparison of the various problems of first-generation and non-first-generation learners.

A careful glance over the magnitude of the mean values shown in the table and Figure 1 reveals that for all the areas of problems, the mean values of the non-first-generation learners are higher in comparison to the mean values of the first-generation learners except the problem related to finance, residence and employment. It indicates that in the case of adolescents of non-first-generation learners all these problems are comparatively stronger than in the case of adolescents of first-generation learners.

But the  $Z_1$  and  $Z_2$  values are found statistically insignificant even at 0.05 level. This leads to the conclusion that the two groups of adolescents have more or less the same problems. Learning generation does not influence or create any variation in the various problems of Indian adolescents.

A comparison of the two groups of adolescents according to different areas of problems reveals the following results.

### *1. Problems Related to Finance, Residence and Employment*

The first-generation learners (FGL) expressed their prior problem to be related to finance. They felt that they did not have sufficient money to meet their own daily expenses. It is obvious that the first-generation learners belong to poor families having limited resources. Most of the guardians of first-generation learners work on the basis of daily wages. Sometimes they do not have jobs. Also, they do not have proper shelter or residence for living.

Hence the FGL adolescents felt the need for a job or part-time work so that they could meet their own personal expenses to help the family.

For non-first-generation learners (NFGL) financial problem was in second order. Their prior problem was to develop social relations and have spare time to avail of recreations and enjoy with their friends.

The recreation and social problem is also expressed by first-generation learners, but it is in second priority.

The present findings are confirmation of the findings of Huddar and Mrinal (1987), Mrinal and Rekha (1994). Huddar and Mrinal (1987) reported that the family background of adolescent first-generation learners was very poor; they were unable to meet the complexities of modern life.

### *2. Personal and Psychological Problems*

In both the groups this problem is third in rank. The FGL and NFGL adolescents felt that they were very aggressive, excited, subject to high anxiety, and hence they forgot. They were very careless, lazy, depressed, unable to take decisions quickly. Thus both the groups suffered from frustration and feelings of inferiority.

### *3. Vocational and Educational Problems*

First- and non-first-generation learners are equally burdened with this problem. In order of priority, this problem is in fourth place. Both the groups, FGL and NFGL,

were worried about their future careers and had a problem availing proper guidance to choose the appropriate subjects for higher education as well as for a suitable job. The two groups equally wanted to be become self-dependent.

#### *4. Moral and Religious Problems*

The first-generation learners have this problem in fifth order of priority; while the non-first-generation learners also suffered from this problem, they were not very conscious about moral and religious implications like first-generation learners. For them this problem is in seventh place.

#### *5. Adjustment in School Activities*

This problem was comparatively higher among non-first-generation learners than among first-generation learners. The former group (NFGL) was comparatively more conscious about the subjects they had taken as course of study. They were worried about high performance and good achievement while the FGL group had perceived this problem in the sixth order of rank.

#### *6. Social and Psychological Problems*

In the FGL group this problem was comparatively higher than in the NFGL group. The FGL group had given seventh rank to this problem, while the NFGL group had given ninth rank to this problem. The FGL group felt that other members of society were neglecting them, they had poor relations and were not popular figures. On the

other hand, the NFGL group did not give much importance to this problem, as the rank order of this problem for the NFGL group was ninth.

#### *7. Sex and Marriage*

Both the groups had this problem in equal intensity and it is at eighth rank. Psychologically the FGL and NFGL adolescents felt unfit for the opposite sex. They were equally hesitant in developing relations with the opposite sex. They were equally worried about the various sexual diseases, and future life partner and married life.

#### *8. Health and Physical Development*

In physical and health development the two groups were more or less equal. On the basis of the magnitude of mean values, the rank order in the FGL group was nine and in the NFGL group it was 10. This indicates that though the two groups were facing the problems related to their health and physique and had equal problems of health, physical constitution, attractiveness, manners and habits, they had given less priority to these problems in comparison to other problems.

#### *9. Course and Teaching Methods*

For the FGL group, the rank order of this area is 10 but for the NFGL group the rank order is six. This indicates that in the NFGL group this problem was comparatively higher than in the FGL group. The NFGL group was more conscious about the study



facilities it was availing of and felt that the course which they were studying was not related to practical life and did not have much use for a vocational career. They felt that the books and the courses which they were studying were a burden to them and that the teachers were wasting their time in unnecessary discussion of these courses.

### 10. *Home and Family*

The two groups, FGL and NFGL, were

burdened with this problem with equal intensity and its rank is 11 for the two groups. The adolescents of the FGL and NFGL groups stated that family members did not give them proper freedom and treated them as immature persons. They did not have the freedom to take decisions of their own. Both the groups complained that their parents were always criticizing their behaviour and were not congenial.

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# Evaluation and Remedial Teaching in Commerce Subjects at the Plus Two Level

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## Abstract

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*Evaluation is an in-built component of the teaching-learning process to determine the learner's progress in achieving the course objectives. Its purposes are measurement of achievement, diagnosis of weaknesses, motivation, etc. But in recent times it is used mainly for grading the students and for administrative purposes and the real concept of evaluation as a feedback for improvement in teaching has been forgotten.*

*Closed-book examination, open-book examination, oral testing and project work are certain devices which are commonly used for assessment of students' achievement but closed-book examination is more popular. These devices should be used scientifically so as to ensure objectivity. More emphasis should be laid on their use in improving the teaching-learning process than on grading the students alone.*

*In the coming century commerce education will flourish due to the development of a market economy. The contents of courses will change drastically to incorporate international dimensions in curriculum.*

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**E**VALUATION is an in-built component of the teaching-learning process. Without evaluation neither can teachers judge their skill in teaching nor can students know where they stand. It is a process of determining how much progress, if any, students are making towards the achievement of goals set for them in a course. What is taught? And, how is it taught? Depends on examinations. Ideally speaking, whatever is taught should be tested, but in practice it is reversed—whatever is tested, is taught. Examination, due to excessive importance, has become a matter of life and death for students and fails to look for inner abilities like intelligence, creativity and imagination beyond mere scores. It is all a game of memory, and guides, last-minute revision of books, etc. are the means to play it.

The fate of students is decided on the basis of a handful of papers written in a few hours, scanned by different examiners facing different moods, whims, ways of thinking and in reality with no accurate rational knowledge about the examinees but judging them on the basis of a few answer papers.

### **Purpose of Evaluation**

One of the main purposes of evaluation should be to provide feedback for remedial teaching. It is designed to serve one or more of the following purposes.

- To measure students' achievements in terms of the course objectives.
- To motivate students for maximum learning efforts.
- To evaluate effectiveness of teaching.
- To serve as basis of administrative decisions like, promotion to higher class, recruitment, etc.

The examinations in our country at present have been primarily used more for grading students, than for ascertaining the pupil's progress in terms of stated educational objectives of teaching of the subject. Since the marks, divisions, or grades are widely used for promotion to the next class, selection in the institutions of higher learning or for employment, they acquire undue importance for the pupils, teachers and parents. The types of examinations conducted and their undue importance has demolished the real concept of evaluation, which has to be a continuous process, form an integral part of the education system and should be interlinked with the educational objectives.

Majority of the students also perceive that evaluation of their abilities and studies of a whole year in a three-hour examination is not possible. These three hours divide them in two grades — pass and fail. Single paper system and expansion of course contents become tiring. Examinations lead to mental tensions and if something happens to the examinee and he/she is unable to appear in the examination

he/she fails. Examination results are unpredictable and give rise to prejudices in society and are very misleading. The most crucial decision of selection of stream—Science, Commerce or Humanities — is based on examination scores, which creates a complex in the minds of some students that they are worthless. It prevents the students from studying subjects from a learning point of view and makes them marks-oriented. They think that the evaluation pattern and education system are defective. Evaluation should continue throughout the year as comprehensive evaluation is not possible in a mere three hours. The education system and the examination pattern have to be reformed to meet the development needs.

Various methods are used in practice to evaluate specific abilities or skills. Combination of evaluation procedures is needed and will be conducive for development of cognitive, affective and psychomotor domains of the pupils. The purpose of evaluation should be diagnostic i.e. ascertain the strengths and weaknesses of the learners. The system of evaluation should ensure that the learner is fully equipped with the desirable level of knowledge, concepts, ideas, skills, attitudes and values of the subject for a specific level. Different evaluation procedures like closed-book examination, open-book examination, oral examination, practical examination or activity-based project work may be used for evaluation of pupils' performance.

### **Alternative Evaluation Devices**

The teacher is required to use various devices for evaluation of students' progress in commerce. The major forms of evaluation procedures are described below.

#### *Closed-book Examination*

In the present scenario of evaluation patterns the closed-book written examination occupies a prominent place although it has the following shortcomings.

- Mostly requires recall of information and fails to test higher objectives like understanding, skill, application, analysis, critical thinking, synthesis, etc.
- Subjectivity of paper setter, examinees and evaluators.
- Ineffective coverage of contents
- Administrative problems like mass copying, etc.

To overcome these problems there is need of proper planning before administering the test. A question paper should not be a random assortment of questions. The structure of a question paper should be based on the following steps.

- Studying the objectives of the course or unit.
- Determining the length and purpose of the test.
- Preparing design or policy allocating weights to different objectives, content areas and forms of questions.
- Preparing operational layout of design for preparing a question paper or blueprint.

- Framing questions, which should be so worded, that the examinees understand the scope and length of the expected answer.
  - Assembling the questions on the basis of their forms — very short answer type, short answer type, essay type, etc.
  - Preparing clear, specific and pointed directions to examinees in the form of general instructions.
  - Giving specific time limits for very short answer type questions needing fixed response to minimize the chances of common malpractices.
  - Preparing scoring key/marking scheme.
3. One thousand transistors costing Rs 800 each were sent by A of Delhi to B of Bombay on consignment basis. A paid freight amounting to Rs 10,000 and cartage Rs 450. B received only 900 sets as 100 sets were destroyed during transit. B incurred an expenditure of Rs 9000 on account of clearing charges and cartage. Calculate the abnormal loss on transistors destroyed during transit.
  4. A and B are partners sharing profits in the ratio of 21:9; C is admitted on 9/21 share in the profits. Calculate the new profit sharing ratio.

*Essay Type:* Answers within 150 words, marks six to 10 and estimated time 11-18 minutes for each question

### Examples

*Very Short Answer Type:* Answers within ten words, marks one or two and estimated time two to five minutes for each question

1. Mention three methods of valuation of goodwill.
2. Write the name of one business house holding goodwill.
3. Mention two situations in which consignor's account is debited in the books of the consignee?
4. What is insurable interest?
5. Calculate the amount of total assets of a business if its capital is Rs 40,000 and outside liabilities are Rs 60,000.

*Short Answer Type:* Answers within 60 words, marks three to five and estimated time 6-10 minutes for each question

1. Explain goodwill.
2. Explain the Super Profit Method of valuation of goodwill.

1. Explain the circumstances when valuation of goodwill becomes necessary in a partnership firm.
2. Explain the methods of valuation of goodwill.
3. A and B are partners with capitals of Rs 3,00,000 and Rs 1,00,000 respectively. On 1 January 1999, the trading profit (before taking into account the provisions of the deed) for the year ended on 31 December 1998 was Rs 1,20,000. Interest on capital is to be allowed @ six per cent p.a. B is entitled to a salary of Rs 30,000 p.a. The drawings of the partners were Rs 30,000 and Rs 20,000 respectively, the interest for A being Rs 1,000 and for B Rs 500. Assuming that A and B are equal partners, prepare Profit and Loss Appropriation Account and the partners' capital

accounts (capitals are fluctuating) as on 31 December 1999.

4. A and B carried on business in partnership since 1975 sharing profits and losses in the ratio of 2:1 respectively. They admit C on 1 April 2000 for 2/7 share. The actual value of goodwill however on the date was Rs 2,10,000. C contributed the following assets towards payment of his capital and goodwill.

Cash	Rs 10,000
Sundry debtors	Rs 50,000
Stock	Rs 60,000
Goodwill	Rs 50,000

Pass necessary entries in Journal to give effect to the above. Also give new profit-sharing ratio of the new firm.

### *Open-book Examination*

In the present information age education needs to infuse the spirit of self-appreciation, self-explanation and develop the finer sensibilities of students. In open-book examination students will be allowed to consult textbooks, reference books and other materials to answer questions within prescribed time limits. The time limit is a significant factor, which may vary as per the nature of questions, the level of examinees and the available reference material. It would work towards reducing the role of rote memorization and concentrate on testing higher levels of application abilities to solve the problems posed by situations in life. Besides boosting pupils' analytical and divergent approach to a problem, it would also contribute towards stimulating pupil

interest in searching for new avenues of comparing and contrasting with higher learning experiences. Curiosity, searching of different sources of information, choosing the needed material, organizing it and presenting it in the desired manner are some of the abilities which need to be developed. These can be tested confidently in a better way through open-book examinations. They develop self-confidence besides providing opportunity for self-evaluation. Testable abilities through open-book examination are given below.

- Competency to consult reference books, journals, periodicals and modern information retrieval facilities.
- Self-study habits.
- Ability to pull out needed information from different sources, marshal it and apply it to solve different problems.
- Creative and critical thinking.
- Presentation of material in a logical sequence.

Simple problems of application type should be posed to plus two level students of commerce to develop logical thinking about the economic situations, etc.

*Value Points:* The students are expected to provide evidences of

- Originality of thought.
- Depth with reference to content, assimilation and precision.
- Selecting specific, content-based matter, supportive facts and presenting them in a logical manner.
- Relevance, quality and continuity in flow of presentation.

**Example**

1. Elucidate the role of the Taj Mahal in the technological development of India.
2. "It is better to improve the slums rather to go in for slum clearance and rehousing." Do you agree? Give reasons.
3. State the role of consumer forums in the modern age of globalization and privatization.

**Oral Testing**

Two important vehicles of communication, oral and written, are to be developed in a balanced manner and also evaluated appropriately. Oral examination is a face-to-face question-answer activity between the examiner (s) and the examinee. The examiner asks questions and the examinee attempts to answer them. Finally, the examiner judges the quality of the answers and grades the examinee accordingly. A panel of examiners may participate in a *viva-voce*, interview and quiz contest or panel discussion to test objectivity. Teachers invariably spend a major part of their teaching time in putting forth questions

to pupils. It stimulates students to study and tests their knowledge, understanding and application abilities and also helps in diagnosing weaknesses on the spot.

Use of oral tests is suggested more (about 100 per cent) at the lower primary level and it should be reduced gradually to 10 to 20 per cent upto the plus two level. Oral testing becomes compulsory in all practical examinations and project work.

Oral examination should be administered skillfully to achieve valid and reliable results. The teacher should ask questions loudly and clearly so that the examinee listens, understands and responds properly. Weights to different aspects should be determined in advance to have uniformity in marking by more than one examiner. Recording of marks will be done separately and later the average will be awarded. Personality traits like quickness, gesture, confidence, alertness, reaction time, etc. should also be given importance at the time of evaluation or responses. Oral examination tickets in the following format may also be developed to ensure objectivity.

S.No.	Question	Expected Response	Marks
1.	Which sector contributes more to strategic fields of industrial development in India?	Public sector	2
2.	Name the situations when valuation of goodwill becomes necessary in partnership business.	Admission, retirement, death of a partner or changes in profit sharing ratio.	2
3.	What was highlighted in the Economic Policy of 1991?	Globalization, Liberalization and Privatization	2



Scoring Sheet for oral testing is developed in the following format.

**Oral Test Scoring Sheet**  
(Record of Performance)

Class..... Section..... Subject..... Unit.....  
Date..... Name of the Examiner.....

S.No.	Name/Roll No.	Area Marks	Content	Expression	Communicability	Total	No. of Question	
			10	5	5	20	Asked	Answered
1								
2.								
3.								
4.								

Signature of the Examiner.....

**Project Work or Practical Examination**

Education has to develop the scientific and application ability in learners. The material and procedures used in the execution of project work foster basic skills and understanding that aid in the achievement of social competence. The pupils may be engaged in a variety of activities for development of skills. Proper weight has to be given to psychomotor skills including observation, manipulation, drawing, reporting, etc. Process as well as the products (or results) of performance, are equally important in project or practical work. The process may be judged in terms of accuracy, speed and alertness in performance. Abilities and behaviour like creativeness, research, using library material, recognizing and stating the problems, communication, studying problem-solving, cooperation, planning, construction and evaluation of the materials gathered are required in modern society and may be developed and

boosted in pupils.

The capacities built in students are given below.

- Reading independently from a variety of reference books
- Reading current publications—newspapers, magazines, pamphlets, government bulletins, etc.
- Utilizing modern means of additional information—E-mail, Internet, etc.
- Taking notes and outlining points
- Comparing opinions to determine bias and accuracy
- Using and developing tables, index and appendix
- Studying graphs, tables, charts, etc.
- Presenting oral and written reports.

**Example**

1. Identify a family in your locality living below the poverty line and elaborate the conditions and suggest measures for improvement.
2. Visit a nearby productive firm and

prepare its Manufacturing Account for a month's output and comment on the performance.

3. Conduct a sample survey of 20 families in your neighborhood. Find out the average number of children per family and establish relation with the family income.
4. Visit the local vegetable market daily for a month and study the rates of toma-

atoes, onions and potatoes in wholesale and retail markets. Compare them and analyze the reasons for the difference in rate in the two sets.

5. Given below are the Cash Book and Pass Book pages of M/s Prakash Bros., Malviya Nagar, New Delhi for the month of January 2000. Prepare a Bank Reconciliation Statement and also write the steps that you have followed.

**Cash Book**  
(Bank Column Only)

Date	Particulars	Amount	Date	Particulars	Amount
2000		Rs	2000		Rs
Jan 1	To Balance B/d	21,000 00	Jan 2	By Gopal Bros. (Ch. No. 212)	4,000.00
" 18	" Madhu Indust. (Cheque No. 685922)	5,000 00	Jan 5	" Kumar (Ch. No. 213)	7,200.00
" 25	" Ramgopal (Cheque No. 843729)	7,500.00	" 13	" TV Traders (Ch. No. 214)	2,100.00
			" 15	" Gopal Bros. (Ch. No. 215)	4,100.00
			" 20	" Drawings (Ch. No. 216)	2,400.00
			" 31	" Rent A/c (Ch. No. 217)	1,000.00
			" 31	" Balance C/d	12,700.00
		33,500.00			33,500.00

**Pass Book**

Name : M/s Prakash Brothers  
A/c No. : 4/3980

Address : 29 Malviya Nagar, New Delhi

Date	Particulars	Withdrawals	Deposits	Dr. / Cr.	Balance
2000		Rs		Rs	Rs
Jan 1	By Balance B/d			Cr.	21,000.00
Jan 3	To Cheque No. 8497212	4,000.00		Cr.	17,000.00
Jan 6	" Cheque No. 8497213	7,200.00		Cr.	9,800.00
Jan 16	" Cheque No. 8497215	4,100.00		Cr.	5,700.00
Jan 19	By Clg Ch. No. 685922		5,000.00	Cr.	10,700.00
Jan 20	To Cheque No. 8497216	2,400.00		Cr.	8,300.00
Jan 22	" Exchange	10.00		Cr.	8,290.00
Jan 24	" Interest on Loan	900.00		Cr.	7,390.00
Jan 25	By Clg Ch. No. 843729		7,500 00	Cr.	14,890.00
Jan 30	" Dividend		500.00	Cr.	15,390.00
Jan 31	To Cheque No. 849729	1,000.00		Cr.	14,390.00



3. Arranging questions in the order of difficulty—simple to complex.
4. Administering such tests on the weak students.
5. Analyzing the answer-scripts and identifying hard spots in learning.
6. Taking remedial steps—personal attention, tutorial classes, re-teaching the micro-concept, changing the method of teaching, etc.

The levels of attainment, testing tools and devices, roles of evaluators, etc. should be clearly defined for each subject area and stage of education. The evaluation and the examination should be user friendly and the learner should not have a fear of examination. It should be regarded as a base for improvement in teaching and learning. There should be continuous experimentation with the evaluation processes. It would always be better to evaluate students on the basis of specially designed teacher-made content area tests. The teacher can know upto what extent or depth the student has understood and where he/she needs help. Such help can be provided through remedial teaching.

### Remedial Teaching

Some teachers attempt to handle remedial teaching regularly by working with one, two or three most needy students. This involves extra individual coaching for a few pupils. This procedure may work very well in those classes where there is a great homogeneity of ability with the exception of

one or two isolated cases. Some schools also feel that weak pupils need more help than the help that can be given in the regular classes. They arrange a specially planned programme tailored to the needs of these students. Remedial groups, each containing four to six children, are formed for personalized instruction. The larger the group the more difficult it is to maintain the individualized and personalized relationship which is necessary for recovery of the student.

Remedial teaching should be based on a careful diagnosis of defects and their causes. It aims to correct weaknesses. It may be concerned with two types of deficiencies:

1. Presence of misconceptions
2. Absence of correct concepts.

The misconceptions are to be removed and correct concepts, skills, and attitudes are to be taught which had not been learned but should have been learned.

Due to individual differences it is not possible to plan a remedial programme in advance which may be effective in all circumstances. This work must be geared to the level of the students. There are, however, some basic principles which have universal application in this regard. Some of them are

1. *Begin where the pupil is* : One of the greatest mistakes in all phases of teaching is in assuming that a pupil knows more than he really does. New materials and advanced learning cannot suc-

cessfully be introduced until the pupil has developed readiness for it.

2. *The pupils should be frequently informed of their progress :* By means of regular checking of homework, assignments, numerical problems, tests, etc. and maintaining records, the improvements which are made should be clearly shown. This provides a powerful motivation for learning the subject.
3. *The work must be real and vital to the pupils :* The exercises, which do not relate to real-life situations, will not be effective. Therefore, vouchers of real business houses with current prices should be used. The personal learning needs of the students must be met through active participation.
4. *The work should be accompanied by definite satisfaction on the part of the pupils.*

**5. Abundant and varied exercises, projects and activities should be provided.**

6. The students in regular classes should be handled making provisions for individual differences.

If a student shows poor performance the teacher will have to go slow. Interesting books, sequenced easy to difficult, should be used. For those students whose home conditions contribute to their weakness the teacher would have to interact with the parents and assist in developing a suitable atmosphere in the home for studies.

### Plan for Record of Students' Progress

An annual plan for evaluation must be prepared and the progress of each student should be shown through a Progress Chart in the format given below.

Entry in this chart is made after every

### Progress Chart

**Class** \_\_\_\_\_

Year.....

**Subject.**.....

[illegible]

test. A student's progress in a subject can be easily assessed and communicated in time for remedial steps.

### Students' Self-assessment Card

Apart from the teachers' record, students may also be asked to maintain their unit-wise records in the following format.

agement, human resource development and business management are likely to receive further impetus. A market economy needs women and men in market-related areas to do business across countries. The subjects and contents of courses would change drastically to incorporate international dimensions in the curriculum. Over-

### Self-assessment Record Card

Name.....	Class.....	Section.....	Year.....
Subject.....	Unit.....		
Started on.....	Teacher's Remarks on		
Completed on.....	Duration.....		
List of books, reference books used	Books/References.....		
.....	.....		
.....	.....		
.....	.....		
Difficulties faced	Remedial steps		
.....	.....		
.....	.....		
.....	.....		
Suggestions for improvement	Remarks on student's progress and suggestions		
.....	.....		
.....	.....		
.....	.....		
Student's signature.....	Teacher's signature.....		

Students record their difficulties in a unit and approach the teacher for help.

Commerce education is likely to flourish in the twenty-first century. Besides, courses in marketing, commerce, economics, finance, accounting, personnel man-

agement, human resource development and business management are likely to receive further impetus. A market economy needs women and men in market-related areas to do business across countries. The subjects and contents of courses would change drastically to incorporate international dimensions in the curriculum. Over-

world of commerce is very lively and dynamic, commerce teaching is theoretical. Practicals in commerce subjects would be an ideal scheme which students would enjoy. However, the execution of the same needs consideration.

A variety of evaluation devices should be used by teachers as per need. The students should never have a fear of examinations. They will have to be helped to develop proper study habits, critical abilities and attitudes emphasizing self-initiative, self-study, self-learning and self-evaluation. The teacher should be a facilitator of knowledge and a guide for improvement.

Evaluation should encourage greater activity among students and more interactions with teachers for guidance. The focus should be on observation, grasping, imagination, ready response and communication without fear or faltering which can be well-fostered through oral testing. The student's quickness in supplying the correct and precise answer, clarity of thought, presence of mind, etc. are also to be focused in testing. In subjects like bookkeeping, practical exposure to accounting work is also necessary. For this purpose, printed journal, ledger, cashbook, etc available in the market are also to be used.

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# Process Outcomes in Physics in Relation to Select Affective Correlates of Secondary School Students

## A Study

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### *Abstract*

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*The study aimed at testing the ability of the select affective variables — Attitude towards Science Learning and Science Learning Interest — to discriminate among three levels of process achievement in physics and to find out the extent of relationship of these variables with process outcomes in physics. The data were analyzed by using the statistical techniques—two-tailed test of significance of difference between means for large, independent groups and Pearson's coefficient of correlation 'r'. It was found that the select affective variables could discriminate significantly among high, average, and low process achievers and they bore positive significant correlation with process outcomes in physics.*

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**T**he studies on affective variables are gaining due attention from science educators as affective variables are as important as cognitive variables in influencing learning outcomes. The affective variables refer to the disposition to feel, to react or to adopt an attitude, idea, method or value. The most important among the affective variables are attitude towards learning and interest for learning.

Though there are some studies, which have explored the relationship between affective variables and achievement in science, only a few studies have been undertaken to reveal the nature of relationship between affective variables and process outcomes in science. Germann (1994) found positive significant correlation between attitude towards science and process skills in science. Doran (1995) found positive, significant relation between science enjoyment and process skills in science. The investigators could not find any study which explored the relation between affective variables and process outcomes in physics. The present study is to find out whether the crucial affective variables related to the learning of science — Attitude towards Science Learning and Interest for Science Learning — could discriminate among high, average and low process achievers in physics and thereby find the extent of relation of these variables with Process Outcomes in Physics (POP).

The study was therefore designed with

Process Outcomes in Physics as the dependent variable, and Attitude towards Science Learning (ASL) and Interest for Science Learning (ISL) as the independent variables.

### Objectives of the Study

The major objectives of the study were

- To test whether the select affective variables could discriminate significantly among three levels of achievement (High Process Achievers (HPA); Average Process Achievers (APA); and Low Process Achievers (LPA) through paired comparisons of the mean scores of these groups.
- To find out the extent of relationship of Process Outcomes in Physics with the select affective variables.

### Hypotheses

- There is significant difference among high, average, and low achievers in Process Outcomes in Physics (when paired comparisons are made of three groups) with respect to the mean scores of the select affective variables.
- There is significant relationship between Process Outcomes in Physics and the select affective variables of the study.

### Method

#### *Sample*

The study was conducted on a basal sample of 1000 Class IX students of secondary schools of Kerala obtained using proportionate stratified sampling technique

giving adequate representation to sex of the subjects, rural/urban residence of the subjects, instructional efficiency of the educational institutions and type of management of schools.

### *Tools*

The tools used for the purpose of data collection were

1. Test of Process Outcomes in Physics by Suresh and Joseph (1996)
2. Scale of Attitude towards Science Learning by Suresh and Joseph (1996)
3. Science Learning Interest Inventory by Suresh and Joseph (1996)

### *Statistical Techniques*

The following statistical techniques were used for analyzing the data.

1. Two-tailed test of significance of the difference among means for large, independent groups.
2. Pearson's Product Moment Coefficient of correlation 'r'.

### *Classificatory Techniques*

The total sample was divided into high, average, and low process achievers (HPA, APA and LPA) by using the conventional procedure of ' $\sigma$ '—standard deviation from mean. Mean ' $M$ ' and standard deviation ' $\sigma$ ' for POP were found to be 23.08 and 7.58 respectively. Therefore, HPA included those in the sample with scores in POP above  $(M + \sigma)$  i.e. 30.66, APA included those who obtained a score between

15.58 and 30.66 and LPA included the subjects who scored below 15.58.

### *Analysis and Discussion of Results*

Analysis and discussion of results were attempted in two parts.

1. Test of significance of mean difference of the select affective variables among three levels of process achievement—HPA, APA and LPA.
2. Extent of relationship of POP with the select affective variables.

### *Comparison of the Mean Scores of Affective Variables for the Three POP Groups*

Paired comparisons were attempted for the three POP groups—the pairs being HPA–APA, APA–LPA and HPA–LPA. The groups were compared by using the two-tailed test of significance of difference among means for large, independent groups (Garrett, 1981). The result in this respect is consolidated and presented in Table 1.

The critical ratios obtained for the mean differences of the affective variables among the three levels of process achievement suggest that significant difference exists in the means of the affective variables (ASL and SLE) among the three levels of process achievement. This again suggests that HPA, APA and LPA are significantly different with regard to the affective variables. In other words, the select affective variables could discriminate significantly among HPA, APA and LPA and hence the first

TABLE 1

Data and Results of the Test of Significance of Difference among the Means of the Select Affective Variables among the Three Levels of Process Achievement

Affective Variables	Process Outcome Groups						Critical Ratios		
	HPA		APA		LPA		HPA-APA	APA-LPA	HPA-LPA
	Mean	SD	Mean	SD	Mean	SD			
ASL	73.0	16.28	59.0	17.29	15.02	15.36	9.37	5.31	11.50
SLE	13.0	7.36	9.0	4.87	8.0	8.78	6.9	2.81	7.94

For HPA, N=153; for APA, N=614; for LPA, N=133. For POP, Mean=23.08 and S.D.=7.58. The directions of the critical ratios indicate that the first-named group of a pair has been first in computing differences.

hypothesis is accepted. The positive sign of the critical ratios obtained indicates that higher mean scores were for HPA rather than for APA and LPA, and for APA rather than LPA with respect to the scores on ASL and SLI.

#### *Relationship between POP and the Affective Variables*

The critical ratios obtained in the first part of analysis indicate an indirect association between POP and the affective variables. It is confirmed in this part of analysis by finding the extent of relationship of the affective variables with POP. For meaningful interpretation of the result, the level of

significance at .01 confidence interval of 'r' and the percentage overlap of variance of affective variables with POP were also found out. These results are represented in Tables 2 and 3.

From Tables 2 and 3 it is obvious that the affective variables show significant correlation with POP — for the entire sample (N:900), for HPA (N:153), and for APA (N:614). The correlation is not significant for LPA (N:133).

#### *POP and ASL*

The obtained value of 'r' for the entire sample is .394. The .01 confidence interval of 'r' ranges from .3215 to .4665. The

TABLE 2

Pearson's Product Moment Coefficient of Correlation of POP with Affective Variables

Affective Variables	Whole Sample			
	Correlation with POP	SEr	.01 Confidence Interval of 'r'	Percentage Variance
ASL	0.394	.028	0.3215 to 0.4665	15.52
SLI	0.325	.030	0.2482 to 0.4019	10.56

TABLE 3  
Pearson's Product Moment Coefficient of Correlation of POP with Affective Variables  
for the Three Groups (HPA, APA and LPA)

Affective Variables	HPA				APA				LPA			
	r	SEr	.01 Confidence Interval of 'r'	% Variance	r	SEr	.01 Confidence Interval of 'r'	% Variance	r	SEr	.01 Confidence Interval of 'r'	% Variance
ASL	.220	.077	.0214 to .4182	4.83	.203	.039	.1030 to .3026	4.11	.057	.086	-.01855 to .2985	0.42
SLI	.206	.077	.1284 to .4055	4.23	.118	.040	.0156 to .2210	1.40	.072	.086	-.01505 to .2414	0.52

coefficient of correlations varies from .57 to .220 for HPA, APA and LPA. The coefficient of correlation between POP and ASL for the whole sample is significant beyond .01 level of confidence. This suggests a true relationship between the two variables. Though the relationship is significant, it is of low degree. The sign of 'r' is positive. This suggests that a decrease or increase in one of the variables results in a corresponding decrease or increase in the other variables. The percentage variance shared in common by the two variables is 15.52. That means 15.52 per cent of the variance of POP can be attributed to the variance in ASL.

### POP and SLI

The obtained 'r' for the whole sample is .325. The .01 confidence interval of 'r' ranges from .248 to .467. For the three groups, HPA, APA and LPA, the coefficients of correlation vary between .072 and .206. The relationship between POP and SLI is significant beyond .01 level of confidence. The size of 'r' indicates a low, positive and significant correlation. The .01 confidence interval of 'r' suggests that the probability of the population 'r' to be in the interval .148 to .402 is .99. The percentage variance shared between the variables is 10.56, which suggests that about 10.56 per cent of the variance in the scores of POP can be attributed to the scores of SLI. The relationships are significant for the two groups HPA and APA of POP

(HPA,  $r = .206$ , APA,  $r = .118$ ). It is not significant for the LPA group (LPA,  $r = .072$ ).

Based on the analysis described above, the hypothesis that there is a significant relationship between POP and the affective variables is accepted.

### Conclusion

The analysis of the data shows that the affective variables—Attitude towards Science

Learning and Science Learning Interest—are capable of discriminating among the three levels of Process Achievement in Physics (high, average and low). It also confirms that Process Outcomes in Physics bear a positive significant correlation with select affective variables. It throws light on the need of exploring the variables which affect the process achievement of low process achievers, which shows a deviation from the results of HPA and APA.

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